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INVESTIGATION OF THE POLLUTION OF TIDAL WATERS OF MARYLAND AND VIRGINIA WITH SPECIAL REFERENCE TO SHELLFISH-BEARING AREAS

Hugh S. Cumming

Public Health Service
Washington, D. C.

March 1916

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MARCH, 1916

INVESTIGATION OF THE POLLUTION OF TIDAL WATERS OF MARYLAND AND VIRGINIA

WITH SPECIAL REFERENCE TO

SHELLFISH-BEARING AREAS

By

HUGH S. CUMMING

PREPARED BY DIRECTION OF THE SURGEON GENERAL

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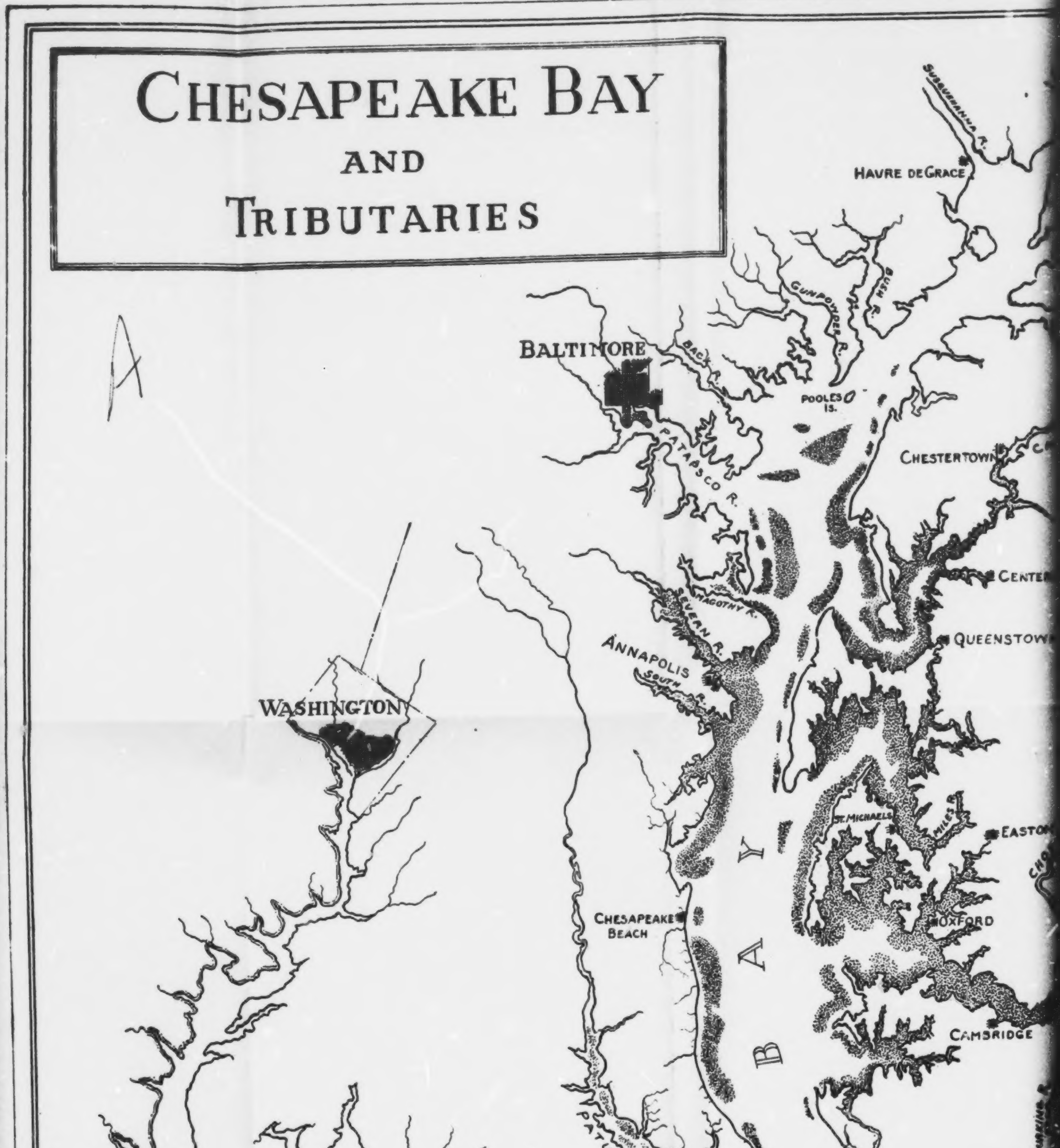
MAP No. 1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BUSH R.
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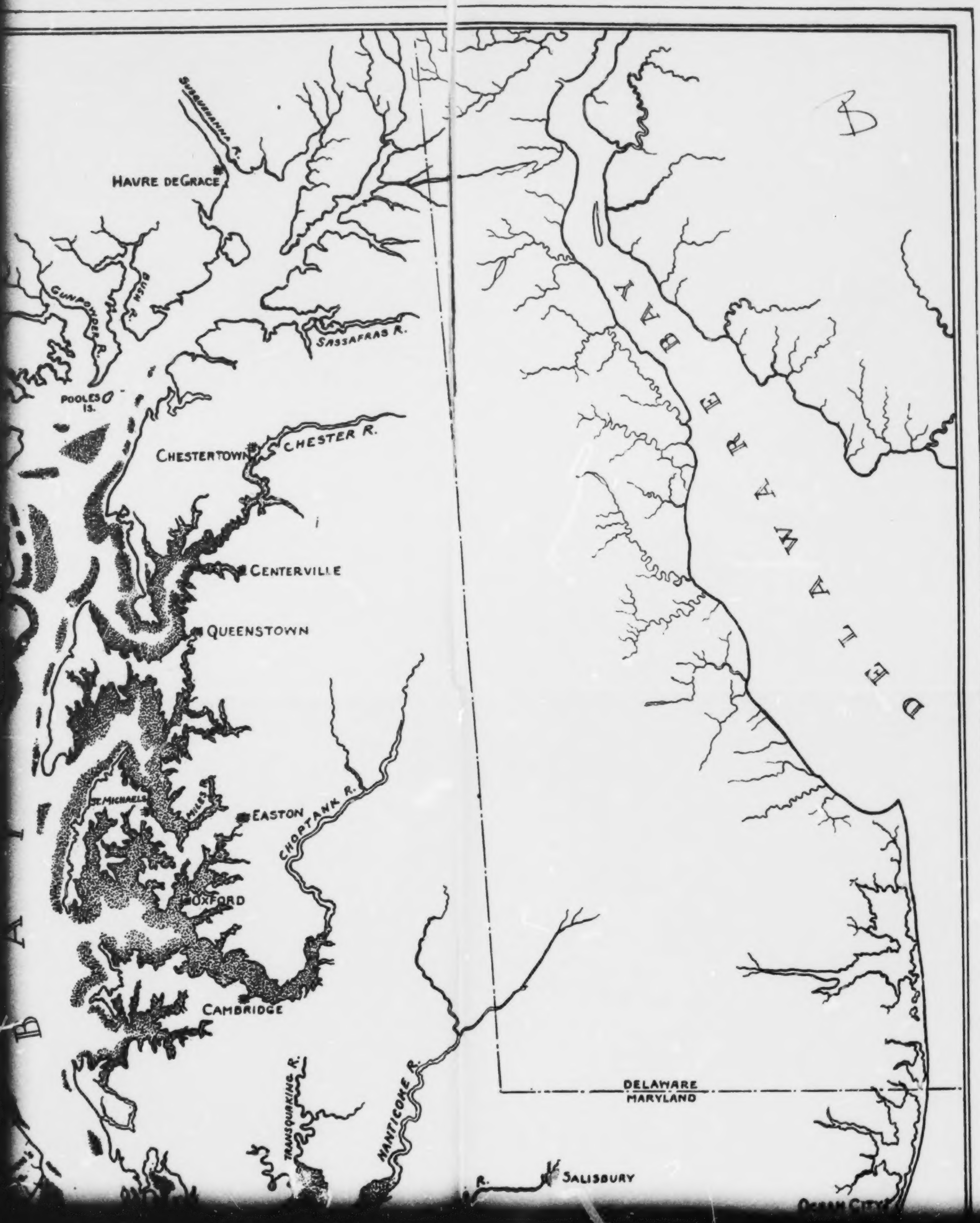
BACK R.
POOLES IS.
PATAPSCO R.
CHESTERTOWN
CENTER
QUEENSTOWN
MAGOTHY R.
SEVERN R.
ANNAPOLIS
SOUTH R.
WASHINGTON
ST. MICHAELS
MILES R.
EASTON
BAY
CHESAPEAKE BEACH
OXFORD
CAMBRIDGE
PATUXENT R.
SOLOMON'S IS.
TRANSQUAKING R.
MARYLAND
VIRGINIA
FREDERICKSBURG

MAP No. 1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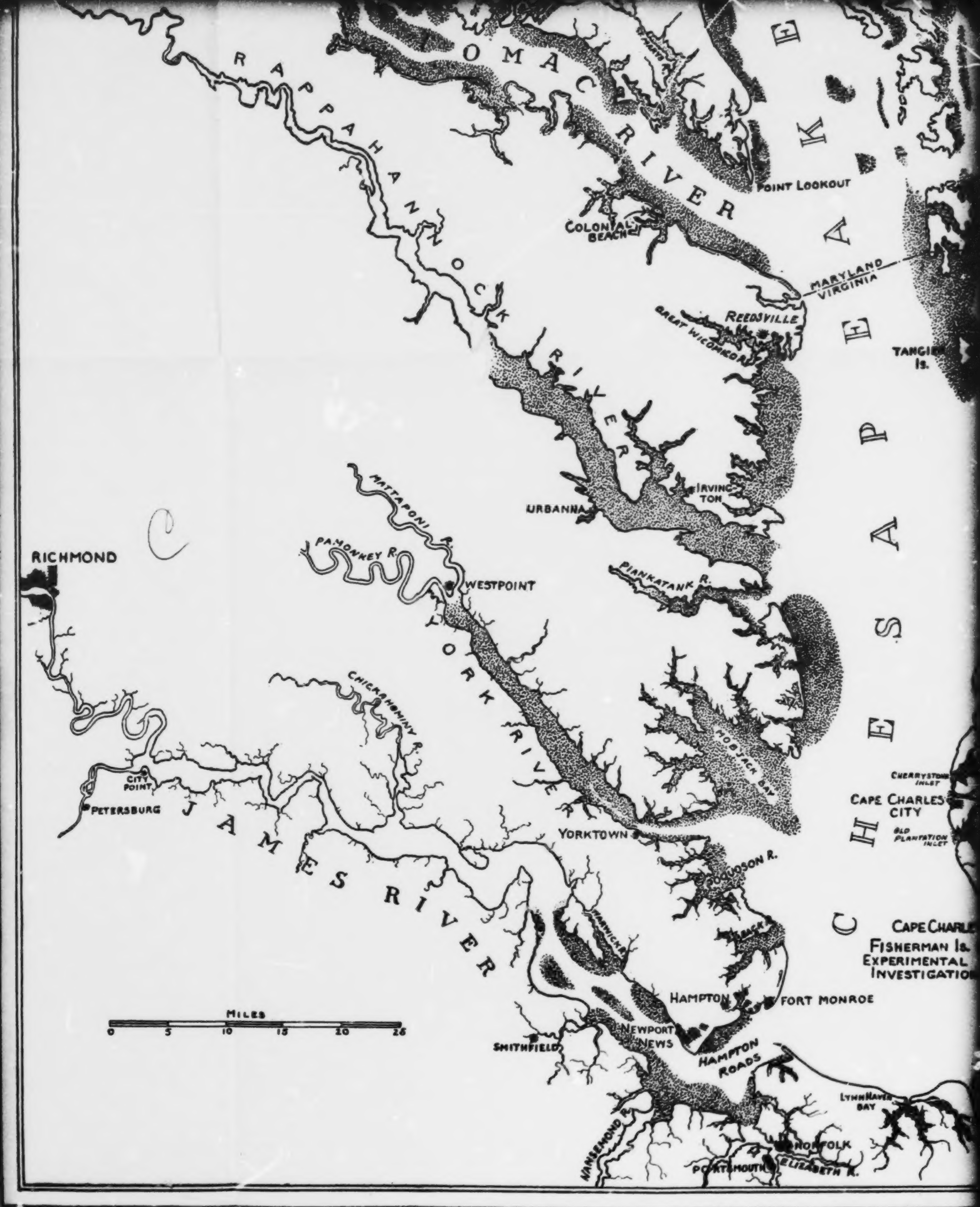

POTOMAC RIVER
CHESAPEAKE
POINT LOOKOUT
COLONIAL BEACH
MARYLAND
VIRGINIA
REEDSVILLE
GREAT WICOMICO R.
TANGIER Is.
RAPPAHANNOCK RIVER
IRVINGTON
URBANNA
MATTAPONI R.
PAMUNKEY R.
WESTPOINT
PIANKATANK R.
RICHMOND
C
YORK RIVER
MOBJACK BAY
CHERRYSTONE INLET
CAPE CHARLES CITY
OLD PLANTATION INLET
CHICKAHOMINY R.
CITY POINT
PETERSBURG
JAMES RIVER
YORKTOWN
POQUOSON R.
WARWICK R.
BACK R.
CAPE CHARLES
FISHERMAN Is.
EXPERIMENTAL
INVESTIGATION
MILES
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25
HAMPTON
FORT MONROE
SMITHFIELD
NEWPORT NEWS
HAMPTON ROADS
LYNNHAVEN BAY
NANSEMOND R.
NORFOLK
PORTSMOUTH
ELIZABETH R.

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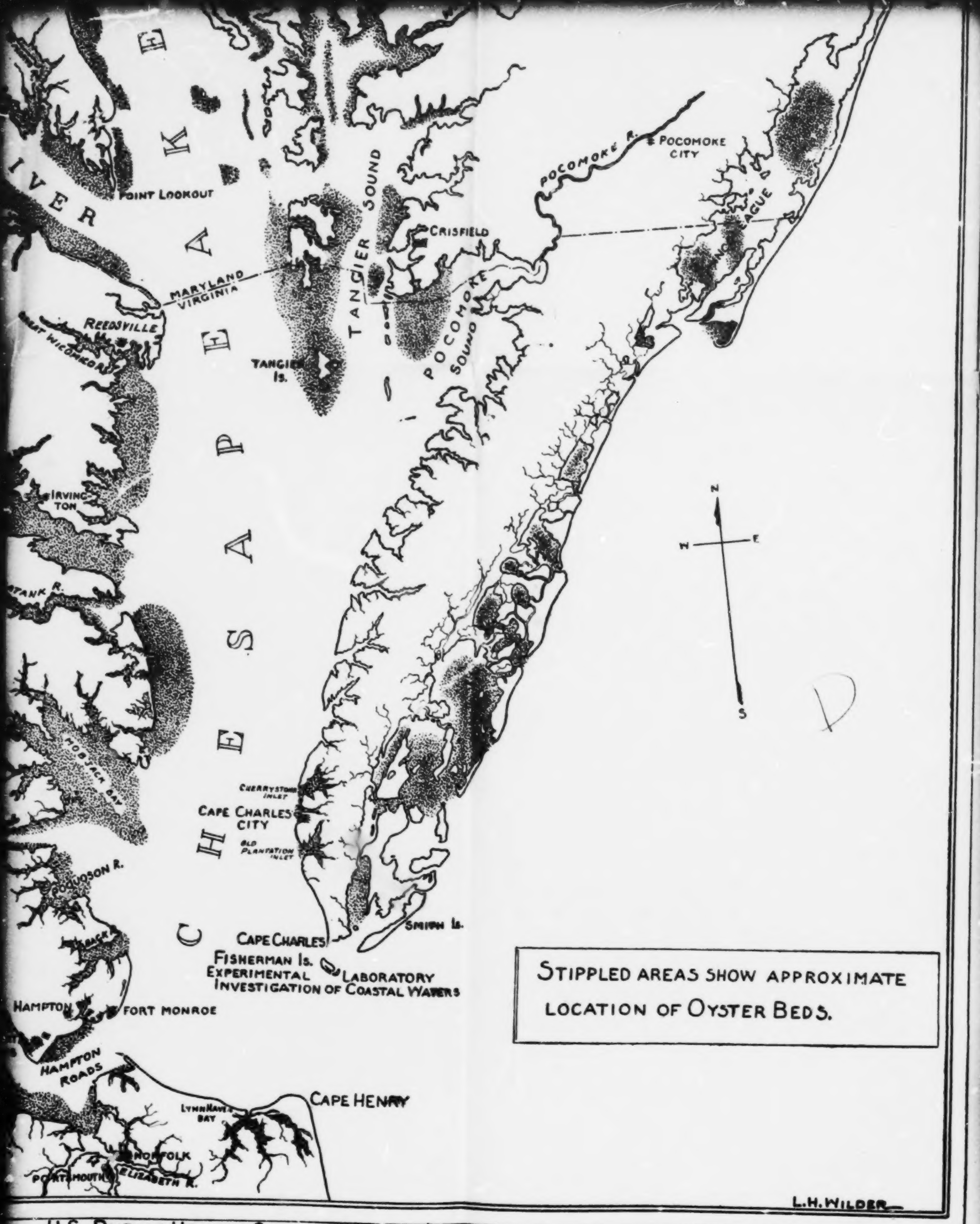
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POINT LOOKOUT
MARYLAND
VIRGINIA
REEDSVILLE
GREAT WICOMICO R.
IRVINGTON
TANK R.
MOBJACK BAY
POQUOSON R.
BACK R.
HAMPTON
FORT MONROE
HAMPTON ROADS
NORFOLK
PORTSMOUTH
ELIZABETH R.
LYNNHAVEN BAY
CAPE HENRY
TANGIER IS.
TANGIER SOUND
POCOMOKE SOUND
CRISFIELD
POCOMOKE R.
POCOMOKE CITY
AGUE
CHERRYSTONE INLET
CAPE CHARLES CITY
OLD PLANTATION INLET
SMITH IS.
CAPE CHARLES
FISHERMAN IS.
EXPERIMENTAL LABORATORY
INVESTIGATION OF COASTAL WATERS
N
S
E
W
D
L.H. WILDER

STIPPLED AREAS SHOW APPROXIMATE LOCATION OF OYSTER BEDS.

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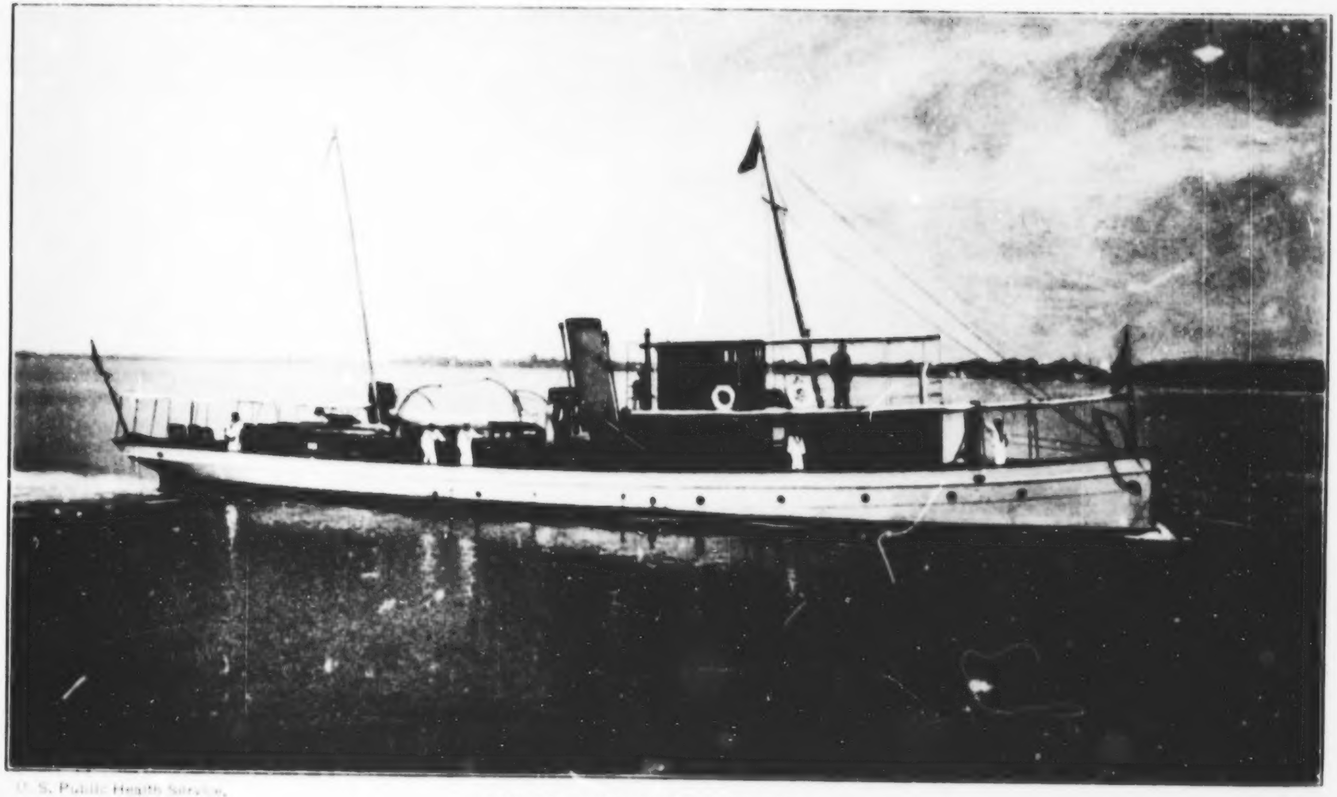

U. S. Public Health Service.

LABORATORY STEAMER "BRATTON."

AN INVESTIGATION OF THE POLLUTION OF TIDAL WATERS OF MARYLAND AND VIRGINIA.

By Hugh S. Cumming,
Surgeon, U. S. Public Health Service.

INTRODUCTION.

Under authority of the act of Congress approved August 14, 1912, which among other things provided for investigations of the pollution of navigable waters, and following a request made by the authorities of Maryland, Virginia, and the District of Columbia, the Public Health Service began in June, 1913, a study of the Potomac River and its watershed. This investigation was continued for about a year and included a study of the pollution and self-purification of the Potomac River with special reference to the sanitary condition of the shellfish beds in the river and its tributaries. The results of these investigations are reported in Hygienic Laboratory Bulletin, No. 104, 1916.

With the approval of the department, the scope of these studies was extended on February 11, 1914, and the officer in charge of the Potomac River investigation was detailed to take charge of the new work. His studies were to have for their object the determination of the state of tidal water pollution and its effects on the public health, and were to include sanitary surveys of watersheds and a laboratory examination of water, mud, and shellfish. The studies were to begin at the mouth of the Potomac River and extend north and south, so as to include especially all navigable tidal waters of Maryland and Virginia in which shellfish or other sea products are grown for human consumption. The steamer *W. D. Bratton* was used for the collection of samples and for laboratory purposes. In September, Sanitary Chemist W. F. Wells who with Sanitary Bacteriologist H. V. Stewart assisted the officer in charge of the investigation, was detached from the vessel and placed in charge of an experimental field laboratory at the United States Quarantine Station at Fisherman's Island, located just south of Cape Charles at the entrance of Chesapeake Bay.[1] A report of the results obtained at this station will be published subsequently. It will deal with the best methods for determining the presence of infectious organisms in the shellfish, the influence of environment, temperature, and other factors upon such infection, and the time necessary for infection when the shellfish are submersed in polluted water, or for the removal of infection when they are placed in nonpolluted water.

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[1] See map 2.

In outlining a plan for the present investigation, two methods presented themselves as alternatives. A single locality might be selected because of the magnitude of its shellfish industry and probable danger of infection and the energies of the entire party concentrated there throughout the year to the exclusion of all other sections; or an attempt might be made to make as exhaustive a preliminary survey as practicable of all parts of the area, in this way locating the most dangerous points and thus eliminating the danger of the spread of disease by notification to the proper authorities. The latter course was adopted, it is now believed wisely; and while no attempt has been made to secure samples of shellfish from every bed in the Chesapeake Bay and its many tributary waters, nor to make a complete sanitary survey of every community, no locality of importance has been overlooked. The results in detail are recorded in a table at the end of this report. When evidences of dangerous pollution were found, the proper Federal and State authorities were notified.

The opinion seemed to be general among oyster planters and oyster men consulted with during the investigation that a thorough and impartial survey would safeguard the oyster industry by directing attention to the few points of danger which do exist and by relieving other sections from unjust suspicion.

The State and local authorities in both Maryland and Virginia rendered valuable assistance and cooperated cordially in the work. It is desired to acknowledge here especially the help given by Dr. Ennion G. Williams, commissioner of health of Virginia, Dr. John S. Fulton, commissioner of health of Maryland, Mr. B. L. Purcell, commissioner of the dairy and food division of Virginia, and Inspector G. W. Taylor of the same division. Commissioner of Fisheries John Parsons, of Virginia, and the Shellfish Commission of Maryland assisted by furnishing maps and other information; and the local oyster inspectors, whenever requested to do so, cooperated cordially.

The governor of Virginia also has taken a personal interest in the progress of the investigation. As a result active measures were adopted this year by the State looking toward the prevention of the taking of oysters from areas reported by this service as being polluted. Such areas are now guarded by vessels detailed for the purpose by the Commissioner of Fisheries.

The great value of the investigation is being shown by the agreement made by the authorities of Virginia with officers of other States to accept the certificates as to purity of oysters given, by the increased market for oysters, and above all by the interest which has been aroused in securing for the State the adoption of laws regulating the pollution of its waters and thus protecting its shellfish industries and water supply.

EQUIPMENT AND TECHNIQUE.

The service steamer *W. D. Bratton* was equipped and used as a floating laboratory. Its equipment included one large 20° and one large 37° Hearson, oil-heated incubator, which worked admirably even under the most adverse conditions of heavy seas and varying temperature; an autoclave with steam supplied from the vessel's main boiler; and a large stock of glassware and other apparatus essential for the work. The Barthel type of alcohol burner was found to be quite as efficient as a gas-burning Bunsen burner for use in sterilizing loops, oyster knives, and the outside of the oyster shells.

Samples.—Surface samples of water were collected in glass-stoppered bottles previously sterilized in their paper wrappers. For the collection of many of the deep samples vacuum tubes were used. Samples of oysters were collected with tongs, or when practicable with a small hand dredge worked from the steamer *Bratton*. In shallow water small boats were used, and an officer invariably accompanied the collecting party. Notes were made at the time of collection upon cards such as is shown below:

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OYSTER CARD.

INVESTIGATION POLLUTION OF COASTAL WATERS.

Sample number **Date collected** **Hour** **a. m.,** **p. m.**
Source:
Wind: **Weather:** **Tide**
Current flow
Temperature of water
Depth collected
Turbidity **Chlorine** **Diss. Oxy.** **Nitrites** **Nitrates**
Ditto Incubated

No. of Colonies on—				B. COLI TESTS BY—														
Agar 37°, 24 hrs.		Agar 20°, 48 hrs.		LACTOSE BILE.								LACTOSE BROTH.						
Amount.	Count.	Amount.	Count.	Dilution.							Score.							Score.
				Oyster.	Gas.	Endo.	Gas.	Endo.	Gas.	Endo.		Gas.	Endo.	Gas.	Endo.	Gas.	Endo.	
....	....	....	....	1......	...	...	...	...	...	...	......	...	...	...	...	...	...	....
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....	....	....	....	5......	...	...	...	...	...	...	......	...	...	...	...	...	...	....
Colonies per c. c.: 20° 37°					Rating=							Rating=						

Sampling points were located by reference to buoys or prominent points on shore. In the waters of the Chesapeake Bay it was not thought necessary to locate sampling points by the use of instruments other than the ship's compass.

Methods followed.—The methods followed were in general those recommended by the Committee on Shell Fish Examination of the American Public Health Association. Oysters were scrubbed in the water from which they were taken. Except where otherwise noted their examination was begun within a few hours after collection, the usual routine being to collect samples as early in the day as practicable and to examine them the same day.

One per cent saline solution was used in making appropriate dilutions of the oyster liquor and water, the dilutions being varied in accordance with the indications. Durham fermentation tubes were used and are preferable to Smith tubes for work on a floating laboratory, because they occupy less space and because the rolling of the vessel splashes the contents of a Smith tube against the cotton stopper.

For reasons fully discussed in the report upon the Potomac River,[1] B. coli determinations were made by the use of lactose peptone broth, confirmed on Endo's medium, instead of lactose bile. The lactose broth tubes were maintained for 48 hours at 37°; smears from all tubes showing gas and from the next highest dilution were made upon Endo plates. These plates were maintained at 37° for 24 hours, and if negative for B. coli—i. e., if they had no characteristic colonies with a metallic sheen—smears were again transferred from the fermentation tubes to Endo plates. No further confirmation was attempted, nor considered necessary.

A composite sample, made with equal quantities of shell liquor from each oyster in a sample, was plated in duplicate in nutrient agar, the plates maintained at 20° for 72 hours and then counted to determine the total bacterial content per c. c. Water samples were plated in duplicate in nutrient agar and the total count determined after 24 hours at 37°.

In the examination of oysters in the laboratory five or more individual oysters of suitable size and shape were selected and flamed, particularly around the edges; the oyster knife was flamed and the oyster opened as carefully as practicable. The end of a sterile graduated pipette was then used to agitate the liquor in the shell and thus secure a fair sample of liquor, including mucus and feces, the required amount being drawn into the pipette.

Endo and nutrient agar media were made at the Hygienic Laboratory, placed in 200 c. c. quantities in 250 c. c. Erlenmeyer and

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[1] Hygienic Laboratory Bulletin No. 104.

Florence flasks, and shipped to the vessel where they were kept in the wings next to the steel hull, thus insuring equable temperature. The broth was made on the vessel, and Liebig's beef extract was used in the place of beef. This method had been thoroughly tested in previous work, and the resultant broth had been found to be as satisfactory as that made from fresh beef. The comparative simplicity of this method also commends itself for use in surveys such as the present one. The temperature and saline readings were determined with a salinometer having a self-contained thermometer. Turbidity readings were made by comparison with permanent standards.

The medical officer in charge is fully aware of the objections to the present methods for the bacteriological examination of shellfish and the limitations of such methods, but considers that no more reliable means have as yet been suggested. One of the most important studies at the experimental laboratory on Fisherman's Island is an attempt to improve the present method.

SCOPE AND OBJECT OF STUDIES.

This report is the result of an investigation of the tidal waters of Chesapeake Bay, of its tributaries, and of the ocean-side waters of Maryland and Virginia. No attempt has been made to take samples of shellfish from all of the half-million acres of oyster-producing bottoms; but it is believed that the investigation has included a sufficient study of every locality from which shellfish are shipped, or are taken for local consumption in any considerable quantity, fully to justify and warrant the conclusions derived and the recommendations made.

Shellfish beds shown by bacteriological examination to be polluted are always a source of danger. In the present state of our knowledge, however, beds should not be considered entirely free from danger, even though pollution can not be demonstrated by bacteriological examinations. Under such conditions these should be supplemented by studies of the topography, currents, and epidemiology of the adjoining watershed.

Relation between infectious diseases and oysters.—During this investigation it has been impracticable to determine the total pollution from those portions of the watershed distant from tidal waters; but this distal pollution is deemed insignificant in comparison with the proximal pollution of the watershed near the beds. In studying the latter an attempt was made to secure from State and local health officials such epidemiological data and expressions of opinion as would possibly assist in the determination of the relation between the pollution of shellfish beds and the prevalence of infectious diseases. The results of these inquiries have not been very satisfactory. Typhoid fever is unfortunately so common in this country, and the sources of infection so many, that it is difficult to exclude several possible causes in any particular case. Again, carelessness and lack of sanitary oversight have been responsible for the failure of attempts made by health officers to determine definitely the agent of infection.

It is significant that, in every one of the cases of typhoid which were reasonably attributable to ingestion of infected shellfish and reported by physicians to us, either the shellfish had been taken from the immediate vicinity of a sewer or privy, or else their origin was unknown. In the latter instances the infection may have been due to such heavy pollution or to infection by carrier. Without quoting the many expressions secured, it may be said that health officers in communities from which oysters are shipped concur in this opinion.

Shellfish as regarded by the public.—For the past eight or ten years the consuming public all over the country has had the opinion that the oyster is a rather dangerous article of food. This opinion has been based in part upon comparatively few well-authenticated and scientifically studied outbreaks of typhoid fever caused by the ingestion of infected oysters, and in part upon cases of gastro-intestinal disorders due to eating shellfish which had been out of the water too long and as a consequence had decomposed. Many cases of typhoid fever due to other causes and many cases of gastroenteritis due to imprudent eating and drinking have also erroneously been attributed by the medical profession, as well as by the laity, to shellfish. In consequence of these conditions there have been many investigations of shellfish pollution, some of them by capable scientists and others by less experienced but conscientious investigators who believed that all shellfish were more or less potentially dangerous; newspapers and magazines have published popular articles; and as a result the public has become afraid to eat oysters.

The immediate result of this condition has been injurious to the shellfish industry; the ultimate result will be a great good to the industry and will be of twofold benefit to the public by preventing the taking of oysters from infected waters and the handling of oysters in an insanitary manner, and by restoring confidence in a safe, cheap, nutritious, and delicious food product, the output of which may be almost indefinitely increased under intelligent legislation.

CHESAPEAKE BAY PROPER.

CHARACTER OF BAY.

With the exception of the comparatively short ocean shore of Maryland and Virginia, all of the tidal waters of the two States are a part of or tributary to Chesapeake Bay. This great body of water is the largest bay on the Atlantic seaboard of the United States. The entrance, in latitude 37° N. and longitude 75° 59′ W. between Cape Charles, Va., on the north and Cape Henry, Va., on the south, is about 10 miles wide, but the shoals extending southward off Cape Charles leave an available width of about 5 miles for vessels of 18 feet draft. The channel, with a depth of over 36 feet, is 1¾ miles in width at its narrowest part.

From its entrance to the mouth of the Susquehanna River, at its head, Chesapeake Bay is about 170 miles long; the lower half has a width varying from 10 to 20 miles, the upper half from 2¾ to 10 miles. The prevailing depth in the lower part is from 24 to 60 feet with a deeper hole in toward the eastern shore above Cape Charles City. From a point a little above the mouth of the Rappahannock River a long, narrow, deep channel, following the general course of the bay, extends to within a few miles of the mouth of the Patapsco River. In this channel the depth varies from 60 to 156 feet. Toward the head of the bay the channel shoals gradually to 12 feet abreast of Red Point at the mouth of Northeast River.

From its entrance to Patapsco River, a distance of 140 miles, the Chesapeake has a navigable depth of 35 feet. A large foreign and coastwise trade enters the bay, bound to the ports on its tributaries, and a very large trade is carried by steamers and sailing vessels between the numerous landings and communities on the bay and its tributaries and the ports of Baltimore, Norfolk, Newport News, Richmond, and Washington. There is also a considerable trade through the Chesapeake and Delaware Canal.

TRIBUTARIES.

The Chesapeake is remarkable for the number, size, and navigable depth of its tributaries. While those on the eastern shore have no large cities or foreign trade, they are much used by vessels engaged in a large local trade in oysters and farm produce. The rivers on the western shore give access to the large commercial cities and ports to which Chesapeake Bay is the approach. All of the rivers and creeks tributary to the bay are subject to tidal influence. With few exceptions, this tidal influence extends to the head of navigation for seagoing or bay vessels.

The eastern shore of the Chesapeake Bay for about 40 miles above Cape Charles, where the entrance of Pokomoke Sound is reached, presents a fairly regular line, broken at intervals by a number of small creeks. North of Pokomoke Sound, which reaches a little above the Maryland-Virginia boundary line, the shore is extremely irregular nearly to the head of the bay, and presents a network of islands, small bays, rivers, and creeks. These intricate waters are of vast commercial importance, for their bottoms are the source of a large proportion of the oysters taken in the Chesapeake Bay areas.

About 5 miles northwest of the entrance to Pokomoke Sound is Tangier Island, the southernmost of a chain of islands which extends nearly 26 miles in a northerly direction. Tangier Sound lies between these islands and the mainland of the "Eastern Shore" and has many tributaries. Proceeding northward, other large bays and rivers of the eastern shore are: Little Choptank River; Choptank River, leading to Cambridge; Eastern Bay, leading to Claiborne and St. Michaels, on Miles River; Chester River, leading to Chestertown and Queenstown; Sassafras River and Elk River. Each of the above has numerous tributaries.

Beginning at Cape Henry, on the western shore, the first principal point is Lynnhaven Roads, a broad, open bight just within Cape Henry, and an anchorage for large vessels. Hampton Roads, about 15 miles westward of Cape Henry, is at the confluence of the Elizabeth, Nansemond, and James Rivers, forming their approach; it is an important anchorage and naval base. Elizabeth River has the coal terminals at Sewall and Lambert Points, and Norfolk on its eastern bank; while opposite are Portsmouth, the United States Navy Yard, Berkeley, the Naval Training Station, Pinner Point, Port Norfolk, and West Norfolk. The headwaters of the Elizabeth River are connected with the waters of North Carolina by two canals. Nansemond River leads to Suffolk; James River leads to Richmond, Petersburg, and City Point; Newport News is on the northern point at the entrance to James River; York River has Yorktown on its western bank, with West Point at its head. Mobjack Bay forms the approach to North, East, Ware, and Severn Rivers. Piankatank River, just north, has a large lumber and oyster trade. Rappahannock River leads to Fredericksburg. Potomac River separates Maryland and Virginia; on its banks are Alexandria and Washington. Patuxent River leads to Solomons Island and is a fine harbor. Severn River leads to Annapolis and the United States Naval Academy. On Patapsco River, 9 miles above its mouth, is Baltimore, the most important commercial city approached through Chesapeake Bay.

DRAINAGE AREA.

The drainage area of Chesapeake Bay includes a large part of the central section of New York, over half of Pennsylvania, most of the States of Maryland and Virginia, and a large section of West Virginia. The population living on this area includes approximately 394,135 in the State of New York, 32,200 in Delaware, 1,613,310 in Maryland and the District of Columbia, 2,541,839 in Pennsylvania, 100,454 in West Virginia, and 1,326,109 in Virginia, a total of 6,008,047. Of this population about 800,000 live in communities immediately on or near the Chesapeake Bay and may be considered the sources of proximate pollution.

The amount and character of the waters of the bay are dependent upon the stream flow from its tributaries and the influx of sea water, which depends upon the force and direction of the wind and the tidal phases. According to observations made by Lieut. Francis Winslow for the United States Coast and Geodetic Survey,[1] the salinity and density of the water in the bay proper varies greatly in the upper or Maryland part of the bay. Nine observations made during the period of least rainfall, October, 1878, at Craighill Channel, mouth of Patapsco River, gave an average of 1.0026, while 10 observations made during the period of greatest rainfall showed an average of 1.0007. Nine observations at Watts Island Light, below Tangier Sound, showed an average of 1.0127 for periods of least rainfall, and 10 samples taken during periods of greatest rainfall showed an average of 1.01109. The waters of the lower bay vary less and are more dependent upon tidal currents. The density of the water in this section approximates 1.020, both in the bay and in the waters on the ocean shore. [The density of the water in the various sections is shown in the general table at the end of this report giving the results of examinations of oysters and water.]

CURRENTS.

The tidal currents in the bay and its tributaries are greatly influenced by the winds, which also affect the rise and fall of tides to a marked extent, especially near the head of the bay. Strong northerly winds increase the ebb current and may interrupt the flood, while strong southerly winds will have the opposite effect. Under normal conditions the velocity of the flood at strength is 1.3 knots and of the ebb 1.3 knots at the "Tail of the Horseshoe" just inside the entrance, while at Sandy Point, near Annapolis, the full flood velocity is 0.6 and the ebb at full strength is 0.7. Other observations follow (from Coast Pilot VI, U. S. C. & G. Survey):

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[1] Appendix No. 11, Report for 1881, U. S. C. & G. Survey.

Tidal currents, Chesapeake Bay.

Stations.	Current turns to flood (hours after high water at Old Point Comfort or Baltimore).	Velocity at strength of flood current.	Current turns to ebb (hours after high water at Old Point Comfort or Baltimore).	Velocity at strength of ebb current.
	H. m.	*Knots.*	*H. m.*	*Knots.*
2.2 miles N. ½ E. from Lynn Haven Inlet	9 00	1.1	2 35	1.2
7.8 miles E. ¾ S. from Old Point Comfort Lighthouse	9 10	1.2	2 43	1.2
3.8 miles E. from Old Point Comfort Lighthouse	9 00	1.4	2 25	1.7
0.7 mile SW. by W. ½ W. from Old Point Comfort Lighthouse	8 10	1.4	1 45	1.5
4.8 miles E. ½ S. from Back River Lighthouse	10 00	1.5	3 30	1.3
2.3 miles SE. ¼ S. from York Spit Lighthouse	9 00	.9	2 30	1.0
4.5 miles ESE. ½ E. from York Spit Lighthouse	10 00	.9	3 30	1.0
1.2 miles E. ½ N. from Wolf Trap Lighthouse	11 15	1.0	4 45	1.1
2.6 miles SE. by E. ¼ E. from Windmill Point Lighthouse	12 20	1.0	5 30	1.1
6.1 miles NNE. from Smith Point Lighthouse	12 25	.5	6 00	.4
2.2 miles SE. by S. from Point Lookout Lighthouse	12 00	.6	5 20	.8
2.8 miles NE. by E. ½ E. from Point No Point	0 55	.5	6 50	.8
1.1 miles WSW. ¾ W. from Hooper Strait Lighthouse	0 00	.5	5 50	.6
3.2 miles SE. by E. ¾ E. from Cedar Point	2 00	.7	8 00	.3
1.4 miles E. ½ N. from Drum Point Lighthouse	1 20	.4	7 00	.6
2.6 miles N. ¾ E. from Cove Point	3 40	.5	9 25	.9
3.4 miles SE. by E. ¾ E. from Holland Point	5 00	.4	10 50	.5
3.3 miles SW. ¾ W. from Bloody Point Bar Lighthouse	5 45	.4	11 25	.5
2 miles WNW. ½ W. from Tilghmans Point	2 40	.5	8 40	.3

The United States Coast and Geodetic Survey (Fourth Report of Shell Fish Commissioner of Maryland) reported that it would take a particle floating on the surface 103.8 days if it followed the main channel, or 138.4 days under average conditions, to travel from Pooles Island to Point Lookout, a distance of about 90 miles.

From the above table it appears that in the whole area from Tilghmans Point to the entrance of the bay the ebb tide at strength has an excess velocity over flood tide of only 0.07 knots. Reckoning 12½ hours of ebb tide a day, and the difference in velocities to be constant, floating particles such as sewage would have a net downward gain of only 0.875 nautical mile a day.

In the lower bay, or area below the entrance of the Potomac River at Point Lookout, the excess ebb velocity at strength is 0.1 nautical mile an hour or 1.25 miles a day.

SHELLFISH AREAS AND PRODUCTION.

Chesapeake Bay and its tributaries constitute the most extensive, prolific, and valuable oyster area known in the world. The shore line is everywhere indented with estuaries, including the lower reaches of the large rivers, in which the combination of brackish waters, suitable temperature, and abundance of food makes possible prolific reproduction and rapid growth of these shellfish.

The region is also favored by the comparative absence of starfish, borers, dog fish, and other enemies of the oyster, which often devastate the oyster beds of other regions. In certain localities in these waters not only are conditions favorable for reproduction and growth, but a combination of certain foods and unknown factors gives to oysters grown therein peculiar and delicious qualities which have increased the value of shellfish from such localities.

The great shell mounds found testify to the importance of shellfish as food for the Indians, and records show the value of shellfish to the early settlers:

> During the first quarter of the last century there seems to have been a brisk local trade in the opening and sale of oysters in cities and towns near the bay. In this early time began the shipping of oysters to the northern field for planting and opening . . . This trade increased in magnitude until the civil war. Out of it grew the present packing business of Chesapeake Bay. A few far-seeing and energetic oyster culturists of Connecticut, recognizing the great natural resources of the bay and the possibilities of a market with Baltimore as a center, established branch packing houses in that city in 1834. These pioneers of the modern business, with characteristic energy, began to establish wagon lines as far west as Pittsburgh. With the construction of the Baltimore & Ohio and other railroads, this distribution was enormously facilitated, oysters were plentiful, and these firms conducted a great business. * * * A few years later Mr. A. Field, also a native of Connecticut, began to sell oysters, which he first steamed and then hermetically sealed in tin cans. This preparation was received with favor and the business grew very rapidly. Records furnished by C. S. Maltby inform us that in 1865, 1,875,000 bushels of oysters were packed raw, and 1,360,000 bushels were preserved in Baltimore. In 1869 he numbers in Maryland 55 packers who put up 5,000,000 bushels. Sixty "raw" houses that year employed 3,000 hands, while the packers gave employment to 7,000 persons. (Kellogg, Shellfish Industries.) During the winter of 1879–80, 45 packing houses in the City of Baltimore marketed more than 7,000,000 bushels of oysters, the total production in the State being 10,000,000 bushels.
>
> The packing business was not begun in Virginia until 1859, when an establishment was started in Norfolk. The Civil War interrupted the business, but immediately thereafter the industry was resumed and has rapidly increased. Very few oysters have ever been canned in Virginia, shipments being made raw, either as shell stock or as shucked stock.
>
> There seem to be no definite data bearing on the production of the entire bay before 1880. The notes of a Baltimore packer estimate the total production of the bay in 1865 at 6,944,500 bushels, of which Maryland produced 4,879,500, and Virginia 2,065,000 bushels. Prof. Brooks states that in 1875 the bay produced 17,000,000 bushels. The census estimate for 1880 was slightly more than that. He believed that the average, for 56 years following the establishment of the packing industry in Baltimore, was 7,000,000 a year, or a total of 392,000,000 bushels.[1]

The greater part of this enormous production was from natural beds, and on account of the continued fertility of the waters the oystermen of both States seemed convinced that they were inexhaustible. As a natural, inevitable result the high tide in the Chesapeake Bay industry was reached years ago (1880). The decline of the Maryland industry is shown by the accompanying chart.

Despite the epoch making investigations and eloquent appeals of Prof. W. K. Brooks of Johns Hopkins in 1878, 1884, and 1891, little

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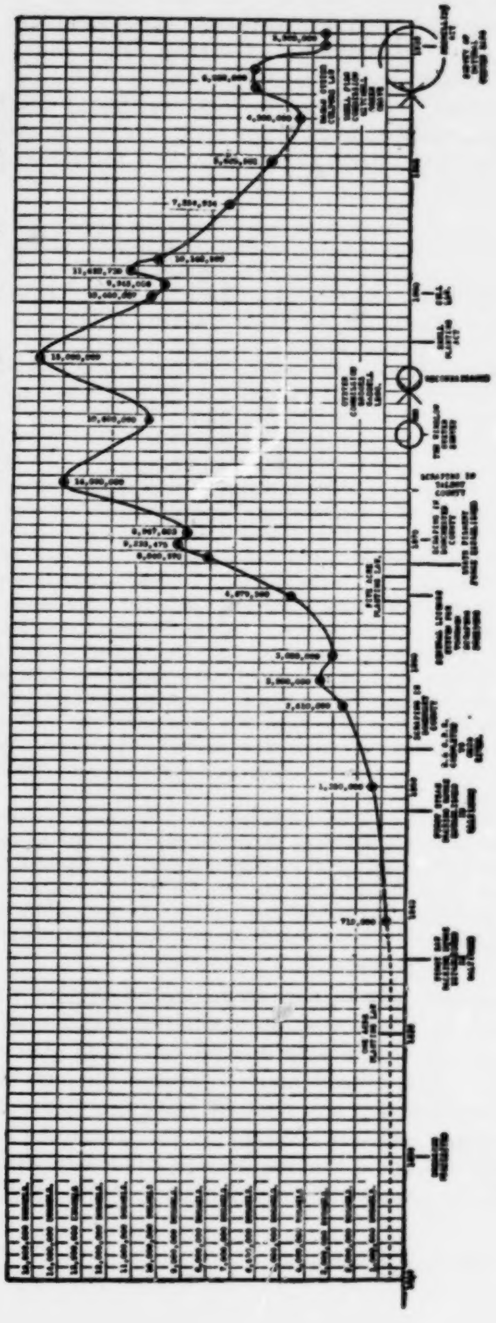
[1] Kellogg in Shellfish Industries, pp. 209-10.

CHART No. 1.

Diagram Showing the History of Oyster Production and Oyster Legislation in Maryland.



legislation to conserve this wealth was passed by Maryland until 1906, though in 1886 a shell planting act and in 1890 a cull law were passed. The Maryland industry has fallen from 15,000,000 bushels in 1885 to 3,500,000 in 1911. During the past year, however, conditions are reported better, though public sentiment among the oystermen is not yet educated to the importance of proper conservative legislation. A complete survey of the oyster areas in the State has been made jointly by the United States Coast and Geodetic Survey, United States Bureau of Fisheries, and the Maryland State Shell-Fish Commission. Their report shows 215,968 acres of natural oyster beds and 100,800 acres of barren bottoms suitable for oyster culture; 506 acres of clam beds were found.

The history of the industry in Virginia has been different. In 1879 dredging was forbidden on public natural oyster rock, and private planting permitted. In 1892 a survey of the natural oyster beds was made, and the results of this survey are embodied in the State Constitution. Provision is made for the lease of other grounds to individuals and for prohibiting the sale, outside of the State, of seed from natural rock. A police or "oyster navy" for the enforcement of law is maintained by each State.

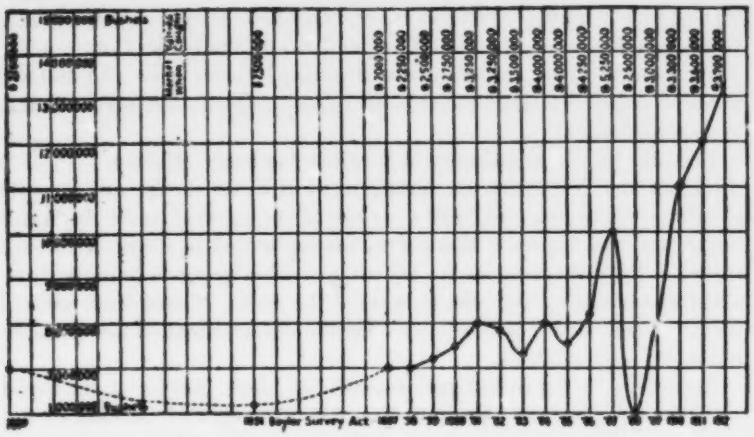
According to the investigation made by Lieut. Baylor of the Coast and Geodetic Survey, Virginia has 226,000 acres of natural oyster bottoms and 400,000 acres open to planting. According to the report for 1912–13 of the commissioner of fisheries of Virginia, there are about 100,000 acres of productive natural rock and 200,000 or less acres suited to planting, of which latter about one-fourth is actually leased for private planting. The oyster beds of the Potomac River are administered by the two States jointly. The public area is worked by about 10,000 to 12,000 tongers and dredgers.

In 1891 Maryland still led in the production of oysters, but in 1901 Virginia marketed 8,000,000 bushels of which 3,000,000 were from private beds. The latter State still maintains supremacy in the production and value of shellfish.

During the year October 1, 1912 to October 1, 1913, there were produced and shipped in Virginia, 7,100,000 bushels of shucked oysters, valued at $6,400,000; shell oysters shipped in barrel and bulk, 3,750,000, valued at $2,100,000; oysters seeded or consumed locally, 1,275,000, valued at $300,000. Of the $8,800,000 received for the output of oysters, about one-third must be credited to labor and the other to the raw product. According to the same report the output of shucked oysters alone from the four principal shipping points during the 12 months from October 1, 1912 to October 1, 1913, was: Norfolk, 1,000,000 bushels, Chincoteague and Irvington, each 400,000, and Hampton, 300,000. From all of these places enormous quantities of "shell stock" oysters are also shipped.

The commissioner of fisheries of Virginia, in his report, September, 1914, states that there were at that time about 14,020 persons engaged in tonging and dredging, and 5,000 persons in marketing, carrying, and handling oysters from public beds, and that at least 5,000 persons found employment upon the 57,336 acres of private beds. He quotes as conservative the statement of the president of the Virginia Oyster Dealers' Association that at least 40,000 persons in the State get their living from the industry. The report shows 101 licensed shucking houses and 16 licensed barrel shippers. It may be stated, however, that many oysters are shipped in small lots from nearly every wharf in tidewater, Virginia.

CHART No. 2.



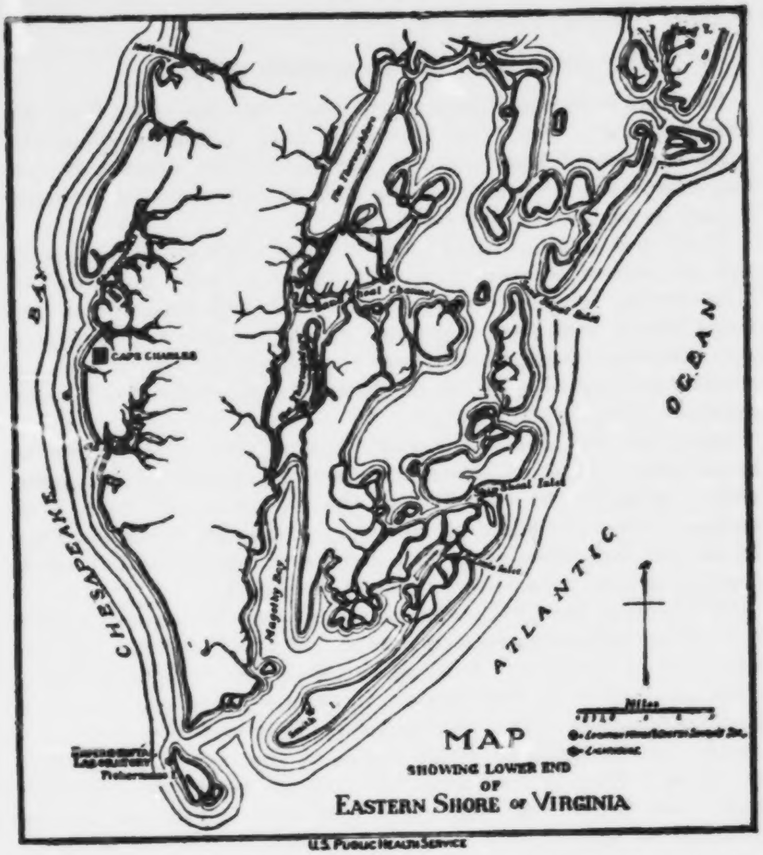
VIRGINIA'S OYSTER RECORD FOR THE PAST 30 YEARS.

From the Fifteenth Annual Report of the Commissioner of Fisheries of Virginia.

"EASTERN SHORE."

The peninsula which stretches in a general southerly direction for about 200 miles, from near the latitude of Wilmington, Del., to the entrance of Chesapeake Bay, with the Delaware River, Delaware Bay, and the Atlantic Ocean on its eastern side, and the Susquehanna River and Chesapeake Bay on its western side, contains the State of Delaware and the sections of Maryland and Virginia known to the inhabitants of those States as "The Eastern Shore." The shores of this peninsula are locally known respectively as "Sea Side" and "Bay Side."

MAP NO. 2.


CHESAPEAKE
BAY
CAPE CHARLES
Magothy Bay
ATLANTIC
OCEAN
Miles
MAP
SHOWING LOWER END
OF
EASTERN SHORE OF VIRGINIA

U.S. PUBLIC HEALTH SERVICE

The whole section is a prosperous, thickly settled agricultural region in which fruit raising, potato and truck farming, fisheries, and the canning industries form the sources of wealth. The shellfish and fishing industries are the principal means of livelihood for the population along both ocean and bay shores.

The mainland of the whole peninsula is well supplied with rail and water transportation facilities, the principal trade of the bay shore going to or through Norfolk, Va., or Baltimore, and that of the inland sections and upper "Sea Side" going by rail to Philadelphia, Wilmington, and New York.

"SEA SIDE" OF THE EASTERN SHORE.

No rivers or creeks of importance empty into the ocean from the Eastern Shore. For over 125 miles, from Delaware along the Atlantic Coast of Maryland and Virginia to Cape Charles, stretch long narrow low lying tongues or islands of sand, sometimes covered in part by pine woods and scrub oaks.

These narrow stretches are known collectively as "The Beach" and the waters between them as "inlets." Partly protected by "The Beach," or lying directly on the ocean side, there are several larger islands whose soil and forest growth indicate a considerable age. Between these islands and the mainland, and forming a considerable part of both, are hundreds of square miles of salt water marshes. (See map 1, page 13.)

Oyster and clam beds.—The water in the narrow guts and creeks in and around these marshes is considerably less salt than the ocean water, owing to the run-off from the watershed and from local springs. These localities are breeding places for those plankton forms, and from them come that detritus of organic matter, which together appear to constitute the food of shellfish.

On the ocean beaches the shifting sands form a bottom so unstable that young oysters are soon smothered, but wherever a firm, permanent bottom exists, or is built up by the deposit of oyster shells or other material which will support the oysters, they may be found in large numbers. The equable temperature and abundant food supply form a condition which results in the rapid multiplication of oysters. Even in areas with mud bottoms, large "natural oyster rock" are found. In such cases spat have apparently become attached to light objects resting on the bottom; during following seasons successive crops have become attached to the older forms and these have gradually sunk until a firm bottom has been formed. These oysters grow very rapidly, and if not disturbed, affect each other's shape, the result frequently being a mass containing dozens of oysters of all sizes and shapes, the characteristic shape being the long and slender "wild oyster" known locally as "cat tongues."

Possibly owing to a deficiency in lime salts, or to their rapid growth, the shells of these oysters are characteristically thin and fragile.

There is also an abundant growth of these shellfish which have the power of locomotion, such as the hard or little neck clam (*Venus mercenaria*) or "quahog" of New England, and scallops; and these mollusks are naturally found even in the less permanent, shifting sands along the coast. The most prolific and valuable clam area along the coast is the flat in Fishermans Inlet, a large part of which is included in the United States Quarantine Reservation of Fishermans Island. The natural supply of these shellfish is being rapidly exhausted along the Maryland and Virginia shores, even as it has been farther north. No State law protects it, and the Federal government should jealously guard the Fishermans Island area as a future source of these clams.

Geographical description.—There are only four communities of considerable size along the whole ocean side: Ocean City, Md.; Franklin City, Chincoteague, and Wachapreague, Va.

Stretching along the coast for about 30 miles, from a point about 25 miles below Cape Henlopen, is a narrow strip of "The Beach" known as Assateague. The lower end of this beach is a mile or more wide and has high sand hills, well covered with forests. Between Assateague on the north and Wallops Beach on the south is Chincoteague Inlet, which is about 1 mile wide, and navigable for large vessels. To the westward of the lower end of Assateague, and separated from it by marshes and narrow, deep creeks, is Chincoteague Island.

Between this island and the mainland on the west are broad areas of salt marshes, covered by extraordinary tides. Sweeping in a northwesterly direction south of Assateague and Chincoteague, and receiving a smaller arm from between Wallops Beach and the mainland marshes on the south, the inlet turns to the north and for about 2 miles is a narrow strait between Chincoteague Island and the mainland marshes. At the north end of this strait, formed by the recession of the marsh and Chincoteague Island, is a broad, shallow sheet of water known as Chincoteague Bay. Separated from the ocean by Assateague Beach, with the mainland to the west, this bay is from 5 to 8 miles wide for about 25 miles north of the strait, where it narrows to a mile or so in width and continues 20 miles or more farther north. The lower part of the latter stretch is Sinepuxent Bay and the broader, upper part is Assawoman Bay.

OCEAN CITY.

Ocean City, Md., is a well-known summer resort, which is situated on "The Beach" between Sinepuxent and Assawoman Bays. The town has a small permanent population of about 500; the majority of the houses are hotels, boarding houses, and summer cottages, and during the summer the population is augmented by 2,000 or more summer residents. During "week ends" and other holidays, train loads of transients are carried from Baltimore and other cities to this resort. At present there is no comprehensive sewage disposal system; sewers are, in some instances, laid from hotels and other houses to the most convenient part of the Sinepuxent Bay shore and the sewage often deposited along the shore. A number of houses have cesspools and privies. Garbage is carried to the shore and dumped or fed to hogs. During summer months shellfish have in some instances been laid for storage in dangerous proximity to such outfalls.

The State department of health has taken steps to remedy these conditions, and plans have been finished for a complete sewerage system. Permit has been issued for passage of the town's sewage through a settling tank and discharge of the effluent into Sinepuxent Bay. Arrangements have been made for treatment of the tank effluents with liquid chlorine should it later be found necessary. (Letter Chief Engineer of State Department of Health.)

The water supply is derived from wells, deep and shallow. The complete absence of reported cases of typhoid fever during winter months, and the occurrence of a small number of cases during summer months when large numbers of visitors are present, suggests that most, if not all, of the cases have been imported or contracted by contact with such cases. There is no indication of continued foci.

Typhoid fever reported in Ocean City, Md.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1908									11				11
1909								6	1				7
1910[1]													
1911							1	1					2
1912							1					1	2
1913								1					1
1914								2	3				5
Total							2	10	15			1	28

[1] None reported.

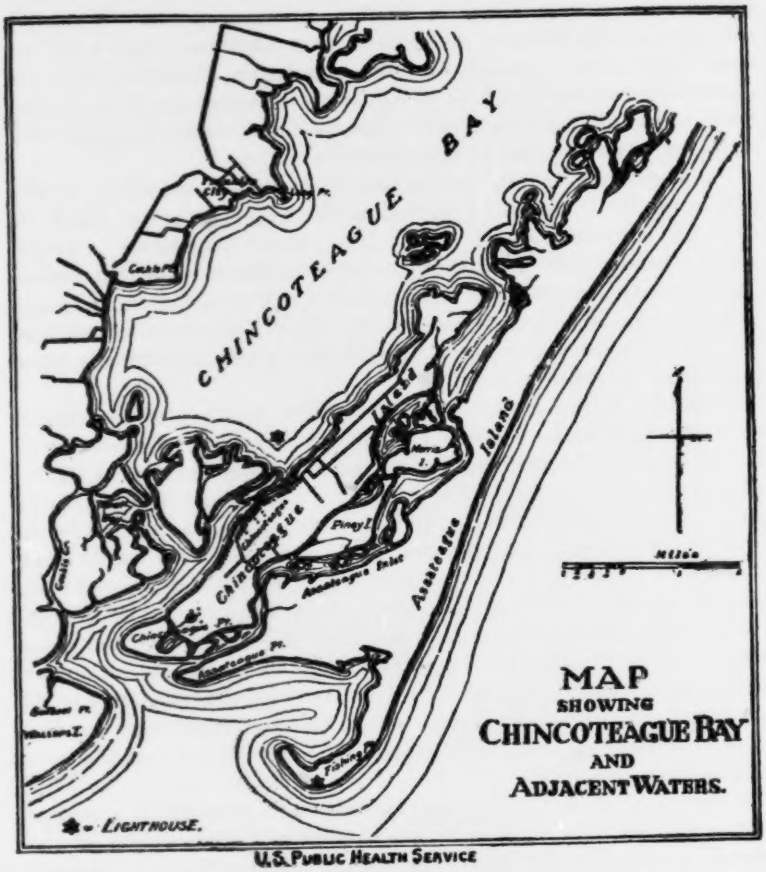
FRANKLIN CITY.

Franklin City is a community of 200 or more persons on the west shore of Chincoteague Bay. The town is the terminus of a branch of the Pennsylvania Railroad system and the shipping point for shellfish and fish which are barged over from Chincoteague Island, as well as for shellfish from local beds. There is no sewerage system; the oyster beds are a considerable distance from the shore. There is no danger of pollution on these beds, but there is danger in the use of "drinking" floats on the foreshore at this town. They have been forbidden by the Food and Dairy Commissioner.

CHINCOTEAGUE ISLAND.

Chincoteague Island is the most populous island and the most important shipping center along the ocean side of the Eastern Shore. Legally it is a district of Accomac County, Va. The island is about 8 miles long, from north to south, and 2 miles broad, from east to west. The surface is a series of low dunes with intervening salt marshes and level bottoms. The soil is sand, covered in the interior with a thin loam which supports a good pine growth and grass enough to feed a few cattle and herds of wild ponies.

MAP No. 3.


CHINCOTEAGUE BAY
Chincoteague Island
Assateague Island
Piney I.
Assateague Inlet
Assateague Pt.
Fishing Pt.
Wallops I.
★ = LIGHTHOUSE.
Miles
MAP
SHOWING
CHINCOTEAGUE BAY
AND
ADJACENT WATERS.

U.S. PUBLIC HEALTH SERVICE

Entering the island from the inlet to the southeast is a narrow slough or gut, from which extends northward for a mile or more a narrow branch terminating in a shallow pond. The tides ebb and flow therein, but seepage decreases the saline content of the water. There are other smaller ponds of a similar nature and these will be referred to again. The west shore is a rather straight sand beach facing the inlet and bay. The Eastern Shore faces Assateague and, as already stated, is separated therefrom by narrow guts or creeks and salt marshes.

Water supply.—There seem to be no permanent springs or streams on the island, the porous soil immediately absorbing the rains or only temporarily storing them in shallow brackish ponds. Repeated attempts, in one instance going down over 2,000 feet, have failed to secure any artesian water, and the population, therefore, depends upon driven wells from 4 to 10 feet deep for water for all purposes. Some of the more prosperous families use for domestic purposes rain water conserved in cisterns and other containers.

Population.—The total population of the island, according to the census of 1910, was 3,295, including Chincoteague town, which in 1910 had a population of 1,419. The present population is about 3,600, of whom 1,800 are within the corporate limits or in that immediate vicinity. Very few of the people live in the interior of the Island and only a small acreage is cultivated. Nearly the entire population live along the shore and derive a livelihood directly or indirectly from the fish and shellfish industries.

With the exception of about 100 negroes, who live in one neighborhood, the population consists of native white stock. Chincoteague town lies along the west shore of the island, facing the inlet or strait, where it is deep but only a few hundred yards wide. The large majority of the people live in houses facing the inlet, on a main street or road which follows the high-water line, and is only a few yards from it. About 50 shops, fish and oyster houses, an ice factory, and residences have been built on the shore-side of the street, generally on filled lands, and their back premises abut the water. Several cross streets, on one of which is a large frame high school, extend for one or two squares from the school. The residences are detached, nearly all are frame, and each has a yard. While few are pretentious, the impression is received that there is no abject poverty, and that the population lives in comfort.

Sanitary conditions.—The town government consists of a mayor and town council. There is no health officer or organization on the island, which is legally under the county health officer of Accomac County, who resides at the court house on the mainland.

Until about two years ago several private sewers from residences emptied on the water front, but under advice of State authorities these, with one or two exceptions, were removed, because of the effect upon the oysters in floats. Some of the houses have cesspools with brick or frame sides but without bottoms, the porous sand being depended upon to carry away liquid constituents of deposits.

Aside from the houses in town, the whole population either depended upon surface privies of the crudest sort or, as in the case of very many houses out of the town, had no privies of any kind. In most instances the water for domestic use is secured from wells driven only a few feet from the privies, and water from the same wells is driven by pump to the oyster floats.

Along the shore in front of the town are 40 or 50 open sheds in which shellfish are barreled for shipment. Alongside each of these sheds are one or more floats for oysters. There is one oyster-shucking house on the shore, with several floats. There are also "drinking places" constructed of water-tight siding and bottoms with a sluice gate through which the sea water may be admitted. Fresh water is pumped into these reservoirs from the shallow wells already described until the mixture is a brackish water of varying salinity, the relative amounts being determined by taste. Within these "drinking places" are pontoon floats, for convenience in sorting and handling oysters. "Drinking places" and the reason given for their use are discussed later. (See p. 30.)

The first inspection of Chincoteague was made by Surg. Cumming, accompanied by State Dairy and Food Inspector Taylor, October 19 to 21, 1914, at which time the "drinking" of oysters had not been begun for the season. An investigation along the water front showed one or two privies very near the floats, and an open bottom cesspool in dangerous proximity to a large clam-shipping plant. A town ordinance required sanitary privies, but as in so many other instances, the idea as to what constituted a sanitary privy was vague. An inspection of premises with the town sergeant showed that, while a few of the privies were adequately equipped for the pail system, the majority were open in the rear. Many of the wells were only a few feet deep and within a few feet of the privies. Inspection of the rural districts showed the same condition, and in some instances, the absence of privies.

Inspection of the ice factory showed that the water was obtained from a gang of shallow wells driven in the abutting cross street and piped to the factory. The manager stated that his water supply was insufficient; that he therefore used some water without distillation and some inlet water, but that he tried to send out for domestic consumption ice made of distilled water only, reserving the other for packing fish.

At the request of the mayor and president of the school board, a visit was made to the high school, where about 600 pupils were crowded into a frame building. A representative of the State board of health had recently advised the building of new privies; it was evident, however, from the design and construction of those being built, that the recommendation had not been understood.

From conversations with three of the four physicians it was learned that there are cases of typhoid fever every year, and that an outbreak of 8 or 10 cases in 1913 had possibly been imported from the fish factory at Assateague. The fever generally appears in August and disappears in September. None of these gentlemen knew of any cases which could justly be attributed to shellfish. As the shipment and consumption of oysters do not begin until September and the "drinking" until November, and as nearly every one eats oysters daily from October until May, the fact that seasonal occurrence of fever and the eating of oysters are not coincident is interesting.

After the inspection the mayor and other officials and citizens were interviewed, and there was impressed upon them the vital importance of the shellfish industry to the community, the danger of spreading disease, and the certainty of interstate shipments being forbidden unless improvements were made in sanitary conditions. They were also advised as to the ease and low cost of removing danger to themselves and their industry by rigid enforcement of a regulation providing for a sanitary dry-closet privy system with prompt removal of contents under supervision.

Survey of oyster beds.—A sanitary survey was made of the oyster beds, and samples of oysters and water from these points, with water from the various well pipes and the large slough or pond, were collected and carried to the Str. *Bratton* for analysis. The bacteriological results confirmed the conclusions drawn as the result of the survey.

The samples of oysters representing all the oyster producing areas on both sides of the island gave a maximum score of only 4. Samples of water from the well pipes, from which water is pumped across the street to the "drinking places" in front of the town, gave high total counts on agar at 37° and a *B. coli* score in 1 c. c. or less. The one sample negative in 10 c. c. had been stored for several days in a tank. The survey and laboratory results demonstrated danger in freshening oysters with water from the wells under prevailing conditions. The results were communicated to Federal and State authorities.

November 16, Surg. Cumming again visited the island by request of the mayor and town council, and addressed a public meeting, during which the nature and methods of transmission of typhoid fever and similar diseases, and the danger of surface wells and insanitary disposal of excreta were explained, in relation both to the health of the community and to the shipment of shellfish. The essential features of a sanitary privy were explained and the council advised as to an ordinance regulating the collection and removal of excreta.

January 25 and 26, a further inspection was made by Surg. Cumming, who accompanied Commissioner of Health Ennion G. Willliams of the State department of health of Virginia. The town council had promptly passed the ordinances as suggested, the people had cooperated with the authorities, the citizens outside of the corporate limits in the country had agreed to abide by the town ordinance, and the one recalcitrant resident had been arrested and fined. In some instances the measures adopted were not quite adequate, but the suggestions of the examiners were received gratefully and steps taken to remedy conditions. Objections having been made to the type of privy used at the high school, workmen were at once employed and the conditions remedied.

By request of the school board, Commissioner Williams and Surg. Cumming addressed the high-school pupils, and afterwards a public meeting of the town council and citizens, upon the importance of town water and sewerage systems. As a result the council decided to communicate with a sanitary engineer with reference to plans for these improvements.

Samples of oysters and water from the floats in front of the town were taken to the *Bratton*, but owing to this vessel having grounded, there was a delay of 72 hours between collection and analysis of samples. Hence February 13 Bacteriologist Stewart proceeded to the island and collected further samples of oysters and water. Of 10 samples of water, 1 was negative and 5 were positive for *B. coli* in 10 c. c., 3 in 1 c. c., and 1 in 0.1 c. c., the latter having been in the float for a week. Of 11 samples of oysters none scored over 2. (See table end of report.)

Importance of the sea food industry.—Statistics gathered about two years ago for the Corps of Engineers, United States Army, and furnished us by Dr. Burwell, show that the trade of the island annually approximates 120,000 tons of freight, valued at $1,577,000. There are practically no agricultural or manufactured articles and the whole of this trade depends directly or indirectly upon the gathering and shipment of sea food.

Almost if not all of the shipments of shellfish are interstate and the market is one which has included points from Utah to Boston. Large shipments are also made to points on the Great Lakes. The largest market, however, is Pennsylvania and especially Philadelphia. From a sanitary standpoint all of such shipments may be sharply divided into two classes; those collected and shipped directly, or without treatment, from the beds, and those previously immersed in water other than that over the beds on which oysters and clams are grown.

I. Absence of pollution in "ocean side" beds.—The first class may be at once dismissed with the statement that both sanitary surveys and laboratory examinations show the Chincoteague beds, in common with all other beds on the ocean side, to be free from infectious pollution. There are no beds on the town side of the channel of Chincoteague Inlet, the beds being opposite the inlet opening, in the bay across the channel from the island, and in Toms Cove and other places between the island and Assateague. The beds of Toms River and the creeks east of the island are free from infection; for the few houses on the shore have no water carriage, the soil is sand and the dilutions, if pollution did occur, would be incalculable.

II. "Freshening" or "drinking" of oysters.—It is asserted by the shippers of Chincoteague and other sections on the sea side, and it is apparently true, that many markets, for instance Philadelphia, demand an oyster with less of the bitter salt taste than the untreated seaside oyster. It is also asserted that these oysters do not keep well for market, as the salts of the liquor appear to dry the mantle and gills and thus injure the appearance and the market value of the shellfish. To obviate these objections and difficulties, which the shippers claim are sufficient to ruin their industry, recourse is had to "drinking" or placing the shellfish in water of lower salinity than the ocean water. A sharp distinction is drawn between this method and the "bloating" by the use of fresh water. As a matter of fact the average water tested was about as salt as the Potomac water about Lower Cedar Point.

There are two methods of drinking: In the one case oysters are carried from the beds and placed in sloughs or guts, where seepage freshens the water, or in shallow ponds in the interior of the island. The more common method, however, is to place the oysters in a rectangular inclosure built on the water front. Into this inclosure sea water may be admitted by opening a sluice, or excluded by closing the gate. The required dilution is obtained by pumping out sea water and adding fresh water. No hydrometer is used and the sense of taste is depended upon to secure the desired result. After immersion in such water for one or two days, the oyster loses the bitter taste characteristic of "sea sides" and is also increased in bulk. There seems to be no good reason to suspect any desire to defraud or deceive by increasing the size of the oyster and almost the entire catch is shipped as "barrel stock," i. e., in the shell, as there is only one shucking house on the island.

As is usual everywhere, a large number of shippers have floats constructed of open slats supported by pontoons, in which oysters are stored for convenience in filling orders. Such oysters, of course, are immersed in the sea water in which the float is anchored. Such oysters are not "floated" oysters in the ordinary sense in which this term is used unless the "float" be in a "drinking place."

Assuming oysters to have been taken from unpolluted beds or layings, as these Chincoteague and other seaside oysters have been found to be, the problem as to the sanitary condition of the shellfish is determined by the quality of the sea water and fresh water used in the process of freshening. So far as the sea water is concerned, under present conditions no considerable danger exists. With the exception of one private drain from a physician's house there is no water carriage from the town. There are generally only one or two vessels anchored in the harbor, and the volume of water which goes through the inlet each tide is enormous.

The conditions under which the oysters were freshened at the time of first inspection constituted a grave danger. The open surface privy or cesspool within a few feet of the shallow well from which water was pumped only a few hundred feet to the floats in which oysters were kept before shipment needed only a case of typhoid fever to complete the chain, and this condition was the usual one along the town water front. The water which supplied the oyster shucking house and its floats came from a well within a hundred feet or so of the manager's house, in which there had been several cases of typhoid fever, and there were stables and other privies in the immediate vicinity. Another float was within a few feet of a drain, and floats carrying large quantities of clams were within 50 feet of a large cesspool.

The danger of infectious pollution was averted by the action of the local authorities in installing a dry-closet system. It must be remembered, however, that there is no local health officer and no health authority other than the mayor and sergeant. These men are energetic and conscientious, but they are not physicians nor trained sanitarians. So long as they enforce the ordinance, the oysters from these "drinking floats" may be considered safe.

The situation here, as elsewhere in the State, shows the necessity of an efficient local health authority and a constant and competent supervision by State officials. Unfortunately, there is no State law which gives to the State board of health authority to prevent sewage pollution; there is, however, a State board of health regulation which requires the installation of sanitary privies and allows the appointment of local boards of health. In view of the fact that almost all of these shellfish are shipped interstate, it is believed that a regular inspection of conditions should be made by Federal or State authority of interstate shipments of shellfish.

The use of shallow ponds and sloughs in the island for freshening oysters is pernicious and should not be tolerated unless the watersheds be inclosed and freed from premises with open privies. They are bad at best. There are several "drinking places" on the east side of the island; all of the water for freshening was secured a safe distance from the privies or residences, and oysters from such waters should be reasonably safe.

SEA SIDE BELOW CHINCOTEAGUE.

Nearly all of the waterways and shores for 25 miles, from Chincoteague Island to Wachapreague, contain either public or private oyster grounds. This stretch includes all of the many shallow areas between the mainland and Wallops, Assawoman, Metomkin, and Cedar Islands.

Folly Creek.—Folly Creek extends from Metomkin Bay, nearly opposite the Metomkin Inlet, for about 5 or 6 miles westward to a marshy head near the village of Accomac Courthouse. On this creek, about 2 miles from the village, is a large oyster shucking house with quarters for shuckers. The oysters were brought by boat from beds in the broad areas, stored in a safe place, and there seemed to be no danger of infection from the shacks. The water used for washing oysters came from a deep well; *B. coli* was absent in 10 c. c., and the sanitary conditions were excellent.

Wachapreague.—Wachapreague, Va., is a village with a population of about 500 persons. On account of the low price of oysters and the bad roads no oysters were being shipped, but there was a considerable trade in scallops. The town is situated on a narrow creek known as Finneys or Wachapreague Creek, several miles from its mouth opposite Wachapreague Inlet. The shellfish shipped from this village are from safe areas.

Willis Wharf, Northampton County, Va.—This is a village with about 200 population on Great Machipongo River, behind Parramore and Hog Islands. On account of its accessibility to the oyster beds on one side and the railroad on the other, this village has developed a large and growing oyster shucking and shipping industry. The creek has been deepened, and there is one old shucking house and three or four modern ones. At the time of the investigation the older one was closed and all of the houses in operation had good sanitary conditions; all had artesian water, and bacteriological examination showed *B. coli* absent in 10 c. c. of each sample. The oysters are brought from beds practically in the open sea.

Oyster, Va.—Oyster is a village of 150 persons whose houses are built around a small cove which makes into Northampton County from the great stretch of water between Cobbs Island and Hog Island.

A large shucking house on the shore secures oysters from the open areas in front and uses water from an artesian well. About half mile south of the village, and constructed on piling 1,000 feet or so from the unhabited shore, is an oyster house, from which are shipped oysters selected because of their condition and gathered from beds free from any pollution; each oyster is marked with a tin tag.

Closets which were fly proof and contained disinfectant solution were provided for employees, and the sanitary conditions were excellent.

Brighton, Va.—Brighton, Va., is another point on the ocean side from which similar "natural oysters" of the sea-side type are shipped with each oyster tagged. The oysters from these sources, as well as the others shipped direct from their beds in the open "broad waters" of the Eastern Shore, are safe from pollution when leaving the beds.

It is hoped that the introduction of such oysters into the best clubs, restaurants, hotels, and markets of the country will familiarize people with the delicious flavor of the natural unfreshened oyster and throw into disrepute the at best doubtful expedient of "freshening oysters."

CONCLUSIONS.

The following conclusions may be made concerning the "sea side" of the Eastern Shore:

1. The natural supply of clams in the Fishermans Island area is being rapidly exhausted. Since a large part of this area is included in the United States quarantine reservation, the Federal Government should jealously guard this area as a future source of clams.

2. In the past shellfish have been laid for storage in dangerous proximity to the numerous sewage outfalls at Ocean City; but the Maryland department of health has taken steps to remedy these conditions, and plans have been completed for a sewerage system with outlet 1,000 feet from shore.

3. The conditions under which oysters were freshened on Chincoteague Island at the time of the first inspection constituted a grave danger. Ordinances requiring a dry-closet privy system were passed as suggested by the Public Health Service, and so long as enforced they should insure that the oysters from these "drinking floats" are safe for consumption. The situation here, however, as elsewhere in the State, shows the necessity for an efficient local health authority and a constant and competent supervision by State officials. In view of the fact that almost all of these shellfish are shipped interstate, it is believed that a regular inspection of conditions should be made by Federal or State authority. The use of shallow ponds and sloughs in the island for freshening oysters should not be tolerated, at least unless the watersheds are inclosed and freed from premises with open privies. Drinking places on the east side of the island are reasonably safe. The Chincoteague beds themselves are free from infectious pollution.

4. The introduction of the natural, unfreshened oyster in all the markets of the country should acquaint the public with its delicious flavor and throw into disrepute the doubtful expedient of "freshening" oysters.

5. Other points on the "sea side" of the Eastern Shore show no infectious pollution. No rivers or creeks of importance enter the ocean along this shore.

"BAY SIDE" OF THE EASTERN SHORE.[1]

LOWER END OF PENINSULA.

Cape Charles City.—Cape Charles City, the southern terminus of the Pennsylvania Company's railroad which connects the peninsula with the northern markets, is the most important railroad and shipping center on the Eastern Shore. The town had in 1910 a population of 1,948, and is growing rapidly. The health officer stated that there were about 2,000 persons within the corporate limits. About 50 per cent of the houses are connected with a sewerage system which discharges into the railroad slip in the harbor. The other houses have surface privies as a rule, and no attempt has been made to enforce a sanitary privy ordinance. The town water supply is pumped from gang wells 40 feet deep and is used generally, though there are surface wells. There is no milk nor food inspection.

The only case of typhoid fever reported for the past year was that of a woman who had not been out of town. The origin had not been traced. An intelligent resident (Mr. H.) stated that about two years before he had suffered a severe attack of typhoid fever, occurring a few days after he had eaten heartily of raw oysters sent him from a bed in a creek near by. The health officer stated that persons in a residence several hundred yards from the bed had typhoid fever a few months previous to Mr. H.'s attack. Another gentleman, however, who had eaten the oysters with Mr. H. had no attack; and other sources of infection in Mr. H.'s case had not been positively excluded.

No shellfish are grown in or taken from Cape Charles Harbor; there are shipped from this place, however, large numbers which have been grown in near-by waters, such as Old Plantation, Kings, Cherrystone, Hunger, and other creeks; and large numbers of clams taken from the flats around Fisherman's, Smith's, and other areas are also brought here for shipment. Such shellfish are from nonpolluted areas.

Cherrystone Creek.—Cherrystone Creek makes into the bay shore of Eastern Shore about 3 miles above Cape Charles City; the estuary is of importance only because of its valuable oyster beds. The 4-mile shore line has a few farm houses, all of which, with one or two exceptions, have ordinary surface privies. Some pollution was found, but very little, and the oysters therefrom are believed to be safe. The name "Cherrystone" is applied to a hard clam a little larger than the small clam known as "Little Neck;" in each case the name no longer signifies the real origin of the shellfish, but simply the size of the clam. Kings Creek is an unimportant tributary in which no pollution was found.

Old Plantation Creek.—Old Plantation Creek is a shallow estuary which makes into the shore about 7 miles above Fisherman's Island

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[1] See maps 1 and 2.

and 3 miles or more below Cape Charles City; the oysters from this creek share the local fame of "Cherrystones." The drainage area is sparsely settled and there is little or no pollution of any sort. Sixteen samples each of water and oysters were taken from these creeks, of which nine samples of water showed *B. coli* absent in 10 c. c. quantities; five were positive in the same quantities; and two were positive for *B. coli* in 1 c. c.; of the oysters three scored 14, and all of the others 5 or less. (See table end of report.)

Harborton and Onancock.—The only communities of any considerable size between Cape Charles City and Pocomoke Sound are Harborton, on Pungoteague Creek about 5 miles above the entrance, and Onancock. The former is a village of about 300 population, from which oysters are shipped.

Onancock is a town of 1,001 inhabitants situated at the head of Onancock Creek, about 5 miles from its mouth. There are a few private sewers which discharge into the creek, but ordinary surface privies are generally used. The water supply is from deep and shallow wells. Onancock, like Harborton, is a shipping point for shellfish, but no oysters are grown in the creek.

POCOMOKE SOUND.

This is an estuary of Chesapeake Bay which makes its way into the Eastern Shore about 43 miles above Cape Charles; it is separated from Tangier Sound by several islands and large shoals, which extend about 10 miles southward from the mainland and are marked near their southern end by Watts Island Lighthouse. The sound is about 13 miles long and about 9 miles wide at its widest part. Large flats occupy almost the whole bottom, leaving a comparatively narrow channel into Pocomoke River at its head, and the numerous creeks which indent its eastern shore. Large areas of both private and public oyster beds cover the bottom, where the depth varies from 6 to 18 feet.

The only possible sources of pollution for this great body of water are Snow Hill, Md., at the head of navigation, 28 miles above the mouth of Pocomoke River, and Pocomoke City, about 19 miles above the mouth; but the oyster beds are out of probable reach of any small amount of sewage which might reach the mouth of the river, while the dilution would be incalculable. No danger exists from these beds.

TANGIER SOUND.

General characteristics.—This sound, on the eastern side of Chesapeake Bay with its southern entrance about 40 miles above Cape Charles, lies between the mainland of the Eastern Shore and several large islands, which extend in a general northerly and southerly direction. It is approximately 27 miles long and has an average width of about 4 miles; it is noted for oyster beds, which are generally found on that portion of the bottom having 6 to 18 feet of water over it.

There are three principal entrances: The southern entrance, between Watts Island Lighthouse on the east and Tangier Sound Lighthouse on the west, has the best water and the greatest width; the middle entrance (Kedge Straits), between Smith Island on the south and South Marsh on the north, is abreast the mouth of the Potomac River and leads into the sound from the westward; the northern entrance (Hooper Strait) leads from the westward, near the entrance to Honga River, into the northern end of the sound.

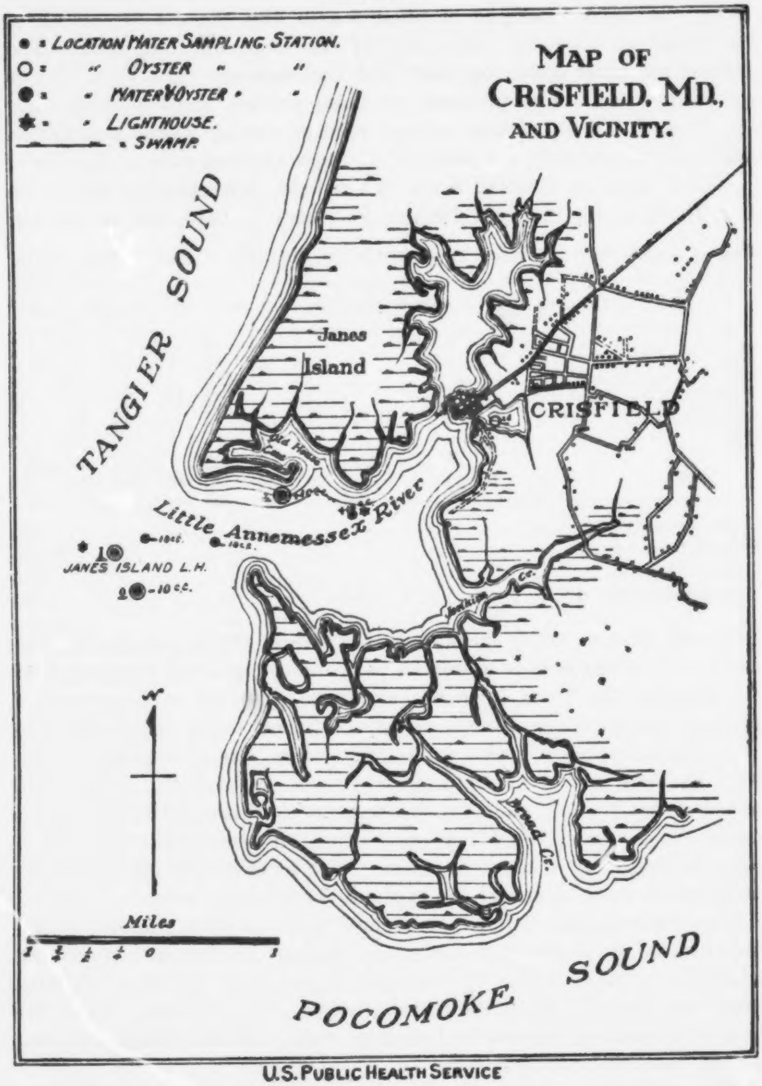
The shores are low, generally flat, and in some parts marshy, presenting few marked natural features. Extensive shoals and oyster beds (with channels between them leading into the tributaries of the sound) extend off from the land on both sides. Watts Island, Little Fox Island, and Great Fox Island extend in a northerly and southerly direction on the eastern side of the southern entrance and separate Tangier Sound from Pocomoke Sound; the openings between these islands are very shallow and can be used only by small boats.

The chief tributaries are Little Annemessex, Big Annemessex, and Manokin Rivers, Monie Bay, Wicomico and Nanticoke Rivers, and Fishing Bay. These are the approaches to several towns and villages which have a large trade in farm produce, oysters, wood, lumber, and general merchandise. A depth of over 5 fathoms prevails throughout the whole length of the sound in the channel, which is quite narrow in places.

Crisfield.—Crisfield, Md., is situated on the east bank of the Little Annemessex River, 2 miles above its mouth. The town had in 1910 a population of 3,478, but is growing rapidly and now has about 4,500. The town has been constructed over marshes, upon which oyster shells have been thrown for years. A branch of the Pennsylvania Railroad and water transportation furnish excellent shipping facilities; and the town is the largest oyster and crab depot on the Eastern Shore of Maryland, besides being the center for the soft crab and terrapin industries of the whole country. The water front is lined with many oyster shucking houses, some of which are modern structures with every facility for handling oysters in a sanitary manner. The vast quantities of oysters shipped from Crisfield are brought from the great beds in Tangier Sound, Pocomoke Sound, and even from the Rappahannock and Potomac Rivers on the west shore of the bay.

It was stated by officials that there were no oysters planted in Little Annemessex River, and it was with difficulty that enough for a sample could be dredged. These came from the mouth of the river. To the east of the town is a wide pond or estuary, a few hundred yards in diameter and only a few feet deep, except where dredged near a causeway and narrow opening connecting this water with the river. We were told by one small dealer that he at times kept some oysters in this lagoon. A number of houses drain into the lagoon, and taking oysters from it should be forbidden. The oysters are probably used locally, the number in this lagoon being small; but it is possible that some infection from this source might

MAP No. 4.


• = Location Water Sampling Station.
○ = " Oyster " "
● = " Water & Oyster " "
✱ = " Lighthouse.
—— = Swamp.
MAP OF CRISFIELD, MD., AND VICINITY.
TANGIER SOUND
Janes Island
CRISFIELD
Little Annemessex River
1 JANES ISLAND L.H.
2 -10 cc.
Miles
POCOMOKE SOUND

U.S. PUBLIC HEALTH SERVICE

injure the great oyster industry of the community as well as cause disease.

The water supply of the town is derived from artesian wells, but there are many shallow wells used. Most of the town has been built along the narrow tongue of filled marsh and faces a street which continues up into the older part of the town on solid land. The houses are built close together, and the ordinary type of privies is generally used. The presence of these privies, shallow wells, and the large numbers of flies always present during warm weather in such places probably account for the high typhoid rate of the town.

The records of typhoid fever in Crisfield, furnished by the State health officer for the year 1908 to February 1, 1915, are as follows:

Cases of typhoid fever in Crisfield, Somerset County, Md., Jan. 1, 1908, to Feb. 1, 1915.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1908	......	......	......	......	......	......	......	......	......	......	4	......	4
1909	......	......	......	......	1	1	6	5	5	1	4	1	24
1910	......	......	......	......	......	......	4	8	......	6	1	......	19
1911	......	......	......	3	1	1	5	1	8	11	11	8	49
1912	5	......	1	......	......	3	14	14	1	13	7	1	59
1913	2	3	4	1	......	1	......	9	3	7	4	2	36
1914	1	......	2	......	......	1	1	5	......	2	4	4	20
1915	1	1	......	......	......	......	......	......	......	......	......	......	2
Total	9	4	7	4	2	7	30	42	17	40	35	16	213

Cases in county	465
Population of county	26,455
Cases in Crisfield	213
Population of Crisfield	4,000

It will be seen from the above that, while the population of the town of Crisfield is only about 15 per cent of the total population of the county, the town furnishes about 46 per cent of the cases of typhoid fever. It is obvious, other conditions being equal, that the chance of infection of foods, including oysters, during handling varies with the amount of typhoid present in a community. The State board of health has taken up the sanitary condition of Crisfield and under its direction the filthy open drain on Chesapeake Avenue is being replaced by a concrete sewer. The local health officer attributes to this drain much of the typhoid fever in the town.

The town is said to be in a receptive mood with respect to the installation of a complete sewerage system, preliminary plans for which have been drawn by the chief engineer of the State department of health. With the installation of such a system, the abolition of insanitary privies and shallow wells, Crisfield should become a very healthful community.

Kedges Strait.—Kedges Strait, the middle entrance into Tangier Sound from Chesapeake Bay, lies opposite Point Lookout and between Smith Island on the south and South Marsh Island on the north. It is the most direct passage from the north to Manokin, Big Annemessex, and Little Annemessex Rivers. The waters of the strait are unpolluted.

Big Annemessex River enters the eastern side of Tangier Sound opposite Kedges Strait. Holland Point, about 5 miles above its mouth, is at the head of navigation, and the small hamlets of Fairmount and Marion are away from the river banks. The river is free from pollution.

Princess Anne.—Manokin River enters the eastern side of Tangier Sound about 20 miles above Watts Island and northeast by east from Kedges Strait. The river mouth is wide but obstructed by oyster beds and sand bars. The only source of considerable pollution is Princess Anne, the county seat of Somerset County, about 16 miles above the mouth of the river. The town is an old one. It had a population of 1,006 in 1910.

The public water supply of the town is derived from several wells, driven about 50 feet deep, in the thickly-settled portion of the town. The sanitary conditions immediately surrounding the wells have been improved, but the water can hardly be considered safe without treatment. The town owns its electric light plant, and the State board of health is considering the use of ultra-violet rays for disinfecting the water.

Most of the town is served by sewers, part of the sewage being discharged into the Manokin River near Main Street, and a part into the river about half a mile west of the town. The river is sluggish and there is no evidence that the small amount of sewage discharged reaches even the upper beds, which are several miles below the outlets.

From the following statistics furnished by the State board of health it is evident that most of the typhoid fever in the town occurs during the late summer and fall:

Typhoid fever reported in Princess Anne, Somerset County, Md., January 1, 1908, to February 28, 1915.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1908									1				1
1909												2	2
1910	1								6		1		8
1911									1				1
1912							2						2
1913							1		2	1		1	5
1914			1				1	3		2	3		10
1915		1											1
Total	1	1	1				4	3	10	3	4	3	30

Cases reported during the same period in the county	465
Population of county according to census of 1910	26, 455
Cases reported in Princess Anne	30
Population	1, 006

Deal Island.—Deal Island, on the eastern side of Tangier Sound and the northern side of the entrance into Manokin River, is a small island on which there is a post village and a total population of 1,524. Large oyster and crab shipments are made from the landing on the island to Baltimore and the northern markets. There is no considerable pollution, and shellfish from this area are unpolluted. Only one case of typhoid fever has been reported since 1912.

Monie Bay and Wicomico River.—Monie Bay and Wicomico River have a common entrance on the eastern side of Tangier Sound, near its head. Monie Bay is shallow, received no pollution, and is unimportant. The entrance from Tangier Sound into Wicomico River is more than 2 miles wide, but is obstructed by large oyster beds, between which is a narrow, crooked channel.

White Haven is a village, with a population of 475 in 1910, on the northern bank about 6 miles above Great Shoal Lighthouse at the mouth of the Wicomico. This town has a marine railway and a considerable trade by steamers. There is no public sewerage system.

Salisbury, a town 20 miles above the mouth of the river, is at the head of navigation and the source of most of the pollution. This community is growing rapidly, the census showing 2,905 in 1890; 4,277 in 1900, and 6,690 in 1910. The present population is probably about 8,000. The town is served by sewers which run to the foot of various streets and the sewage is discharged untreated into the river. There is also a public water supply. Suburban residences, as well as some of those in the community, use privies and shallow wells.

Wicomico County, of which Salisbury is the county seat, had a population of 26,815, in 1910, with an aggregate of 706 cases of typhoid fever reported from 1908 to 1914, whereas, Salisbury, with a population of 6,690 in 1910 has had 459 cases reported. From the following data it may be seen that almost all of the cases occurred during the late summer and fall.

Typhoid fever reported in Salisbury, Wicomico County, Md., from January, 1908 to January, 1915.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1908		1	1			4	26	31	19	19	3	2	106
1909						1	21	8	14	1	[1]2 10		[1]2 55
1910	2			1			9	41	16	4	4		77
1911	1				1		15	56	1	2	1	4	81
1912							9	7	1	5			22
1913		1					[1]1 21	11	2	8	6	4	[1]1 53
1914	2	2				[1]2 6	[1]10 6	[1]4 8	[1]2 4	[1]1 5	[1]2 6	2	[1]21 41
Total	5	4	1	1	1	13	118	166	59	45	34	12	459

[1] Cases in hospital.

Cases in county	706
Population of county	26, 815
Cases in Salisbury	459
Population of Salisbury	6, 690

At the time when samples were taken in Wicomico River (Jan. 22, 1915) the pollution was probably at its maximum, for there had been a heavy rain with northeast wind for two days. *B. coli* was found in 0.01 c. c., at the town and present in 1 c. c. as far down as White Haven. The nearest oyster beds are about 2 miles below this point and at such periods of maximum pollution it is possible that some pollution, though small, might reach these upper beds. These beds, however, are small in extent and the dilution in the mouth of the river and in Monie Bay is enormous. A sample taken in the latter place showed *B. coli* present in 10 c. c. of water, and oysters gave a score of 5 in June.

In Dames Quarter, a small settlement of 250 persons near Monie Bay, there were reported, in 1913, 9 cases of typhoid fever, all in November, and, in 1914, 6 cases, of which 5 occurred in January and 1 in May. The cause of the winter cases could not be ascertained.

Nanticoke River.—This river enters the head of Tangier Sound from the northeast, just north of the entrance to Wicomico River and Monie Bay. About 24½ miles above its mouth the river is divided into the East Branch and Marshhope Creek; several creeks, all unimportant except Broad Creek, enter the river and these branches. Nanticoke River has a channel with a minimum draft of 9 feet to the town of Seaford, Delaware, 36 miles above its mouth. In 1910 Seaford had a population of 2,108.

Laurel is a town of 2,166 persons at the head of navigation on Broad Creek, about 30 miles from the mouth of Nanticoke River. Galestown is a small village 1 mile above Sharpstown, which is a village of 722 inhabitants[1] on the east bank of the East Branch of the river, 28 miles above the mouth of the Nanticoke. Rivertown is a small village 3½ miles above Vienna, which is a town of 332 inhabitants 21 miles above the mouth of the river. The direct sewage entering the river from these sources is inconsiderable and the nearest oyster beds are over 15 miles below Vienna. At the time samples were taken a northerly gale and ebb tide created a condition of maximum pollution. The water gave *B. coli* present in 10 c. c. or greater quantities. No oyster samples scored over 5. The oysters from these beds are believed to be safe.

Fishing Bay and Hooper Strait.—Fishing Bay is a continuation northward of Tangier Sound, above Clay Island and Bishops Head. It is full of oyster beds and the oysters therein are practically free from pollution. One sample taken July 1, between Bishops Head and Sharkfin Shoal in Tangier Sound, gave a score of 32.

Hooper Strait, the northern entrance from Chesapeake Bay to Tangier Sound, leads between Bloodsworth Island on the south and

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[1] In this and in following cases the population figures are taken from the United States census of 1910.

Hooper Island and the mainland on the north. The shellfish from this open water are free from pollution.

Tangier, Smiths, South Marsh and Hooper Islands.—Tangier Island, the southernmost of the islands between the Sounds and Bay, is a part of Accomac County, Va. The island had a population of 608 in 1910. The population is gathered rather closely along one street on a part of the southern end of the island which is not marshy.

Smiths Island is just north of Tangier and has a population of about 685 persons, of whom 60 are in Tylertown and 625 in Ewell.

South Marsh is a small island north of the preceding. Holland Island has a population of 80 and lies west of South Marsh. Bloodsworth Island lies north of Holland Island.

Hooper Island lies northwest of the Strait of that name, and the population is chiefly centered in two small villages, Hoopersville with 125 and Applegarth with 37.

Practically all of the inhabitants of the above islands earn a livelihood by catching fish, oysters, clams, and crabs. The water for domestic use is generally from wells. Privies are used. So far as known, typhoid fever is rarely present, only two cases having been reported in several years.

Honga River.—This river is a large irregular body of water on the eastern side of Chesapeake Bay between the mainland and Hooper Island. It is about 12 miles long and full of oyster beds and shoals, with a channel 19 feet or more deep to within 4 miles of its head. On the northern portion of Hooper Island, about 7 miles from the mouth of the river, is the village of Fishing Creek with a population of about 700.

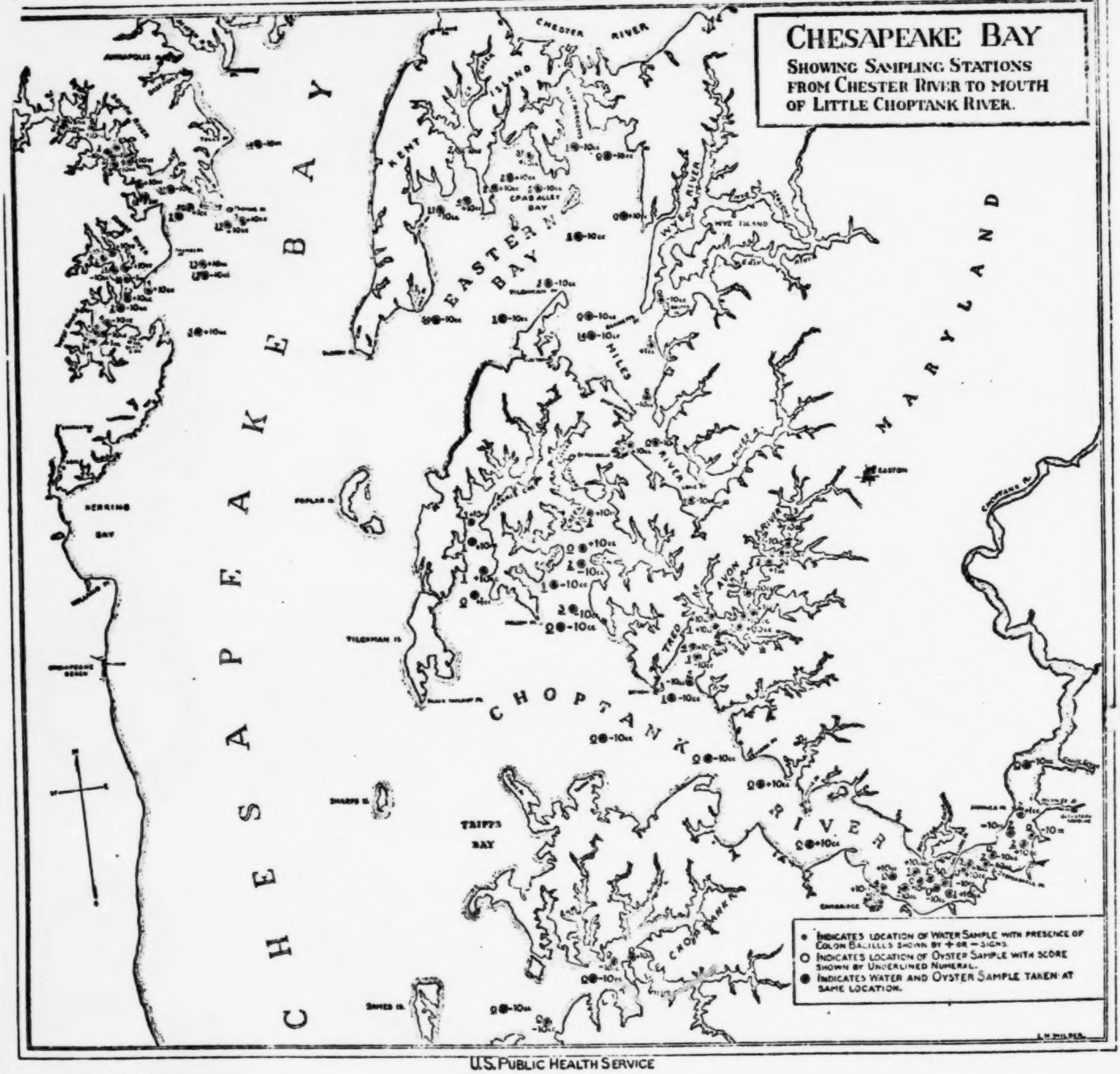
Fox Creek is a large bight in the eastern bank of the river about 2 miles above its mouth. On this creek is Wingate Point wharf, and nearby is the village of Wingate with a population of 325. Southeast of this point, behind a neck of land at the river mouth, is Bishops Head with a population of 250. Hoopersville wharf is opposite Fox Creek on Hooper Island. Very little direct pollution enters this large body of water. The score of 41 in the oyster sample taken July 1, on the edge of the channel at the mouth of the river, as well as other samples, indicates that there is some pollution.

Little Choptank River enters the eastern shore of Cheaspeake Bay about 90 miles above Cape Charles and 55 miles below Baltimore. The shellfish industry is not important and there are no communities contributing pollution.

CHOPTANK RIVER.

This river, with its tributaries, is the most important one on the eastern shore. It enters the bay about 95 miles above Cape Charles and 50 miles below Baltimore. Sharps Island lies off the middle of its entrance, to the north of which is Tilghmans Island. A narrow neck of the mainland marks the entrance on the south. The river is

Map No. 5



CHESAPEAKE BAY
SHOWING SAMPLING STATIONS FROM CHESTER RIVER TO MOUTH OF LITTLE CHOPTANK RIVER.

- ● Indicates location of water sample with presence of colon bacillus shown by + or − signs.
- ○ Indicates location of oyster sample with score shown by underlined numeral.
- ⬤ Indicates water and oyster sample taken at same location.

CHESTER RIVER
KENT ISLAND
CRAB ALLEY BAY
EASTERN BAY
WYE RIVER
WYE ISLAND
MILES RIVER
CHESAPEAKE BAY
MARYLAND
HERRING BAY
POPLAR IS.
TILGHMAN IS.
EASTON
TRED AVON RIVER
CHOPTANK RIVER
SHARPS IS.
TRIPPS BAY
JAMES IS.
CAMBRIDGE
LITTLE CHOPTANK
L.H. WILDER.

U.S. PUBLIC HEALTH SERVICE

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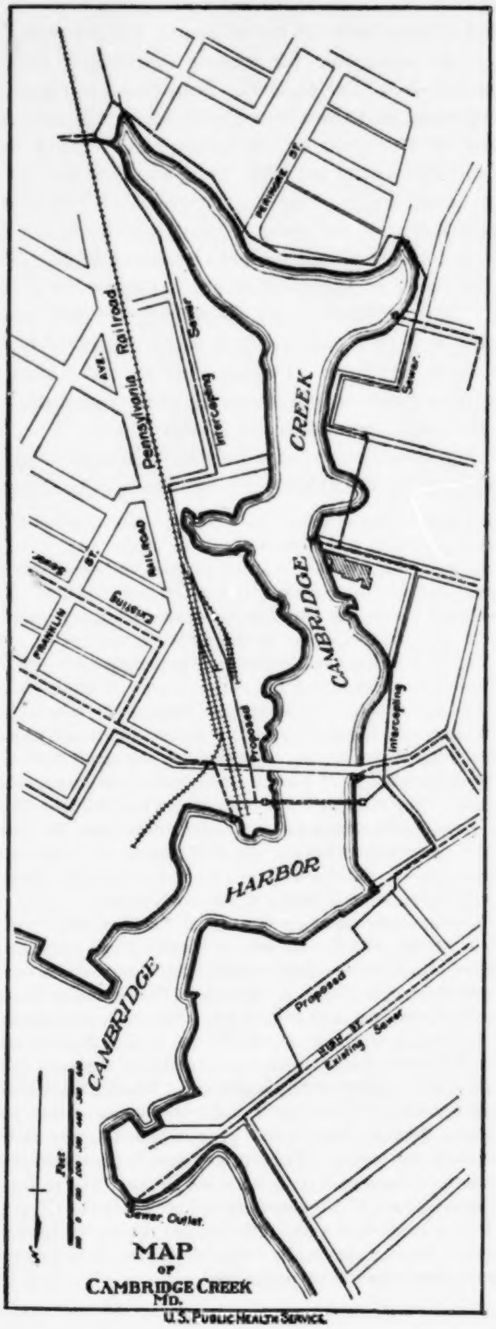
between 3 and 4 miles wide at its entrance, 4 miles wide for 7 miles or more above, and navigable for vessels drawing 8 feet to Denton, which is 56 miles above the mouth. Numerous navigable tributaries enter the Choptank, and there are a number of villages and a few important towns on the river or its tributaries. There are numerous oyster beds and the oyster and fish industries are important.

Cambridge.—Cambridge, the county seat of Dorchester County and the largest town on the river, is built on the south bank around Cambridge Creek about 17 miles above Sharps Island. The town had a population of 6,407 in 1910, but there is at present a total population of about 7,500. There are excellent railroad and water transportation facilities, and as a consequence there is a considerable trade in oysters and farm produce. During the winter season the oyster shucking business gives employment to many persons, while during the summer the canning industry is a large one.

The following description of conditions in Cambridge harbor is taken from a report of the chief engineer, State department of health.

> Cambridge Harbor is a narrow arm of the Choptank River, penetrating the city for some distance and ending in a shallow creek at its upper end. It follows a rather crooked course, is somewhat less than a mile long from the steamboat wharf at its entrance to the upper end, and at no point is it over 500 feet in width. The city is built up on both sides of the harbor, the two sides being connected by a drawbridge at Market Street, and drainage from adjacent sections finds its way into it. That portion of the harbor south of the bridge is usually spoken of as Cambridge Creek. In this report the harbor is considered as including the entire basin. A ditch discharges into the upper end of Cambridge Creek; it is dry at most times of the year, as it drains an area of flat outlying country which furnishes little or no run-off, except during wet seasons. The long, narrow shape of the harbor, together with the small flow of upland water, limits any extensive circulation of its water, and during tidal changes there is but little in or out movement. The discharge of sewage, which has undoubtedly been going on for many years, has caused accumulations of filthy sludge upon the bottom of the harbor, especially near the sewer outlets, as very little chance for removal of the sludge is offered by tidal movement. Such a condition might be borne for a long period without creating any great offense, except locally at the sewer outlets, but for the fact that in summer, when the canneries commence operations, the large amount of cannery waste discharged into the harbor, added to the sewage already there, exhausts all the oxygen in the water, the resulting putrefaction causing such highly offensive conditions that the vicinity of the harbor is almost intolerable. This extreme nuisance exists for nearly three months in the year, and at such times the water becomes so foul that most obnoxious odors are produced. It is no exaggeration to state that the very paint on the houses near the water front changes color, due to action of the gases of decomposition, and it has been said that even silverware is affected. The hulls of white-painted boats are discolored and blackened by the water, and bubbles can be seen rising to the surface in many places, denoting that active putrefaction is going on in the stinking sludge on the bottom of the harbor. Fish life is extinct in the harbor at such times and dead fish and crabs have been seen lying upon the shores. The polluted condition of the harbor is a grave menace to the numerous oyster bars in the Choptank River, the nearest of which is no more than a half mile beyond the harbor entrance. All other considerations aside, the city can hardly afford to jeopardize in this way an industry which is of so much importance to its prosperity.

MAP NO. 6.


Pennsylvania Railroad
Intercepting Sewer
AVE.
CREEK
CAMBRIDGE
Sewer
FRANKLIN ST.
Existing Sewer
RAILROAD
Proposed
Intercepting
HARBOR
CAMBRIDGE
Proposed
HIGH ST.
Existing Sewer
Feet
Sewer Outlet

MAP
OF
CAMBRIDGE CREEK
MD.
U.S. PUBLIC HEALTH SERVICE

Samples of water were collected, during 1913, for chemical and bacteriological analysis from a number of different points in the harbor, beginning at its entrance and extending to near the upper end of Cambridge Creek. These samples were taken at three different times; in March, in August, just before the beginning of the canning season, and in September toward the end of the season. The results of these analyses show plainly the effect of the combination of cannery wastes and sewage in the harbor in the summer when putrefaction is occurring. While the early results show plain evidence of pollution that contributed by the wastes from the canneries aggravates the condition immensely.

During September, 1913, it was found that in the middle portion of the harbor no oxygen was present in the water, a condition indicating most active decomposition. In normally pure water oxygen should be present in a state of saturation of 100 per cent. Its total exhaustion is caused only where the load of pollution is so great that all the oxygen contained in the water is insufficient to meet the demands of the decomposing organic matter. Such are the conditions in Cambridge harbor during canning season, due to discharge of the large volumes of both cannery waste and sewage. Such a situation is as needless in a modern community as it is harmful to public health and progress. It is indefensible and should be tolerated no longer by the citizens of the city.

Local condition caused at the upper end of the harbor, where the two upper Phillips canneries and the Bramble plant discharge their wastes, is also extremely objectionable. The liquid wastes from the Phillips canneries are conveyed by means of a ditch by the side of Washington Avenue to a culvert discharging into the head of the small creek which carries them to the upper end of the harbor where they are discharged into shallow water. The rise of the tide causes the waste to be distributed over extensive flats and whatever solids are contained in them are deposited as the tide recedes, resulting in an accumulation of filthy, decaying organic matter over a foot in depth. Just below the point of discharge of the creek leading from the Phillips's canneries, the wastes from the Bramble factory reach the harbor, resulting in worse conditions still.

All about the canneries on the water front, as well as at the upper end of the harbor where the wastes from the two Phillips canneries and the Bramble factory enter the water is colored a reddish hue, and tomatoes, skins and pulp are seen floating on the surface. While the harbor is not so grossly polluted as to be in a state of nuisance except during the canning season, there is no doubt but that such a condition will occur before many years if the city grows; the discharge of crude sewage both into the harbor and into the Choptank River is dangerous to public health through the chance afforded for the contamination of oyster beds in the vicinity. The only practicable and effective methods of bringing about proper conditions are either by treating the cannery wastes at the individual canneries and collecting the sewage from the various sewers to a point where it would be properly treated and discharged into the river away from the harbor mouth; or by collecting and treating the sewage and cannery wastes together, after which they would be discharged into the river as under the first alternative.

At the time of the inspection of Cambridge by the Public Health Service in January, 1915, there was, of course, no canning going on and the harbor, during that period of low temperature and less organic matter present, gave less evidence of oxygen deficiency and nuisance than during the summer months. The evidence of heavy pollution was, however, very apparent even during the winter season.

A study of map No. 6, showing Cambridge harbor and the present sewer outfalls, makes it quite evident that the present condition, bad as it is, will necessarily become worse with the growth of the city, unless steps are taken to improve the sewerage system. At present there is no comprehensive system. There are about 14 sewers in the principal streets of the congested portions of the town, these sewers generally discharging at the end of each street running to the water front. Of this number four discharge into the harbor on the west side, one on the east side, and nine into the Choptank River. The five outlets into the harbor serve a portion of the business section of the city and a large part of the most thickly built-up residential district, so that the amount of sewage discharged into the harbor is probably greater than that which goes into the river directly. One of the sewers which discharge directly into the Choptank, on the east side, receives sewage from a large general hospital.

The pollution of the harbor is so obvious upon ordinary inspection that no laboratory examinations are necessary to determine its unfitness for shellfish culture. There are no oyster beds in the harbor and, at the time of inspection, there was no evidence of oysters being floated therein. Immediately outside the harbor entrance, however, there are oyster beds. While the dilution of the sewage is very great in the waters of the river and consequently no high counts were obtained, the amount of sewage is sufficient, and fresh enough, to constitute a constant danger from oysters taken within a considerable distance of the outlets.

The Bureau of Engineering of the State board of health has prepared preliminary plans for a comprehensive sewerage system, which will intercept and divert all sewage, including cannery wastes. The outlet will be at a point jutting into the river some distance below the town. The plans include settling tanks, sludge beds, detention tanks, and disinfection of the effluent before discharge, They also include a recommendation that certain oyster beds in the immediate vicinity of the outfall be condemned. Such a system as has been recommended not only will increase the healthfulness and attractiveness of the town, but will remove the danger of infectious pollution from valuable and extensive oyster beds, the sanitary safety of which must now be considered doubtful.

If the typhoid fever statistics for Cambridge and Dorchester County, of which it is the county seat, be compared, the necessity for prompt action for the protection of the town itself is apparent. The calculations are based upon the census report of 1910, and the typhoid returns from January, 1908, to March, 1915. It will be seen that, while the population of Cambridge is only 22.3 per cent of that of the county, the typhoid returns show that nearly 40 per cent of the cases in the county were in Cambridge.

The water supply is derived from deep wells and is of excellent quality, hence it is probable that the morbidity rate would be markedly reduced by the installation of a good sewerage system and the abolition of privies and other easily remedied conditions. The sanitary conditions in this county have been intensively studied by officers of the Public Health Service during the past year under direction of Surg. Lumsden.

Typhoid fever cases reported in Cambridge, Md., from 1908 to February, 1915, inclusive.[1]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1908	2	2	4	......	......	1	16	8	2	2	1	4	42
1909	1	......	......	4	......	......	(9) 14	7	3	8	2	1	40 (9)
1910	2	3	......	......	......	3	(1) 18	31	15 (2)	......	3	......	75 (3)
1911	......	......	......	......	......	......	1	3	6	2	......	3	15
1912	3	......	......	......	......	......	18	61	4	12	......	4	102
1913	......	......	......	1	......	7	6	12	4	11	14	6	62
1914	1	......	2	......	......	1	6	8	3	7	3	......	31
1915	9	3	......	......	......	......	......	......	......	......	......	......	12
													391

[1] Figures in parentheses indicate cases in hospital.

Cases in county	982
Population of county	28, 669
Cases in Cambridge	391
Population of Cambridge	6, 407

Other principal sources of pollution.—The principal sources of pollution in the Choptank, other than Cambridge, are: Denton, a town of 1,481 population, 33 miles above Cambridge; Greensboro, a town of 609, 6 miles above Denton; Choptank, a village of 200, about 12 miles above Cambridge; Warwick River, a small stream entering Choptank River from eastward, about 6½ miles above Cambridge; East New Market, a town of 280 people at the head of the river, 3 miles above its mouth, and Secretary Landing, a wharf and small community from which there is a considerable trade.

The Choptank has many other tributaries, but in no others above Cambridge are there any considerable sources of pollution.

From a few miles above Warwick River to its mouth the river contains extensive and productive oyster beds, and the only area of danger seems to be the small bank in the immediate vicinity of Cambridge Harbor. The conditions there should be promptly remedied, and no oysters taken therefrom under present conditions.

Harris Creek.—Harris Creek enters Choptank River from the north, just east of Tilghman Island. The entrance between Nelson Point on the east and Bar Neck Point on the west is about 2¾ miles wide, but above this the creek is narrow. There are many oyster beds.

The only sources of pollution are Avalon, a village of 100 persons 2 miles above Bar Neck Point, and Tilghman, a town of 575 persons in 1910, about a mile north of Avalon. Both of these communities are on Tilghman Island, near the mouth of Harris Creek. It is possible that the sample taken near Spar buoy 2, which was positive for *B. coli* in 1 c. c. quantities, was due to pollution from these towns. There are other landings up the creek, such as Wittman Wharf, but no sources of considerable pollution.

The typhoid fever occurring on Tilghman Island, lying between Harris Creek and Chesapeake Bay, appears to be due to the use of shallow wells and insanitary privies. The eight cases in December, 1912, are suggestive of some local temporary cause, such as infected food. An outbreak of typhoid fever in Shippensburg, Pa., in November, 1915, has apparently been traced to oysters from a shucking house on this island in which there was a case of the disease.

Typhoid reported in Tilghman, Talbot County, Md.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1909							1	1					2
1910[1]													(1)
1911			1										1
1912								1	1			8	10
1913								6	2		2		10
1914									2				2
Total			1				1	8	5	0	2	8	25

[1] None reported.

Population of island	575
Population of Talbot County	19,620
Number of cases of typhoid in county in same period	229

Broad Creek.—Broad Creek enters Choptank River from the north and on the eastern side of Nelson Point. The creek is 8 miles long and extends to within one-half mile of St. Michaels, on Miles River. This creek receives no considerable pollution.

Tred Avon River.—Tred Avon River enters Choptank River from the northeast, the entrance lying north of Choptank River Lighthouse. The river is deep and from one-half to a mile wide up to the town of Oxford, which is about 2 miles above the lighthouse. The stream becomes narrower and shallower up to the town of Easton, about 9 miles above its mouth. A dredged channel 150 feet wide and with 8 feet minimum depth leads to the wharf at Easton Point. There are several other landings of less importance, including Bellevue, a village of 110 persons, opposite Oxford.

Oxford is a town of 1,191 persons, with few industries. The town is on a rather high point of land formed by the Tred Avon on the west and north, and Town Creek, a small estuary, on the east. The town has no public sewerage system, and ordinary privies and wells are used. Little, if any, direct sewage enters the Tred Avon from Oxford, but oysters should not be taken for food from Town Creek.

Easton is a thriving town which had a population of 3,083 in 1910. The population now approximates 3,500. There is a public sewerage system. The results obtained from the examination of 20 samples of water or shellfish indicate that no serious pollution reaches the oyster beds of the Tred Avon from the Easton disposal system. A further study of the upper beds should, however, be made. The typhoid rate of Easton does not differ markedly from that of Talbot County as a whole. There has not been over one case per annum reported from Oxford. One case was reported in each of the following months: August, 1910; September, 1911; and November, 1914.

Typhoid fever reported in Easton, Md., from 1908 to January, 1915, inclusive.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1908							6		3				9
1909							4						4
1910							2						2
1911	1					2			2				5
1912										3		1	4
1913						2	9	[1] 11 8	5	3	2	3	[1] 11 32
1914							[1] 1	 5	[1] 3 3	[1] 1 6			[1] 5 14
1915	1												1
Total	2					4	22	24	16	13	2	4	87

[1] In hospital.

Cases in county	229
Population of county	19,620
Cases in Easton	87
Population of Easton	3,083

EASTERN BAY AND TRIBUTARIES.

Eastern Bay has its entrance on the eastern shore of Chesapeake Bay, about 106 miles above Cape Charles and 40 miles below Baltimore. It is a large, irregular body of water from 2½ to 5 miles broad and 10 miles east and west and is the approach to several rivers and creeks of importance. Kent Point is the northern and Poplar Island the southern point at the entrance. The bay and its tributaries have extensive shoals composed chiefly of oyster beds, and there is a considerable trade in farm produce and oysters. This vicinity is a favorite summer resort, and the population is considerably increased by visitors during the hot weather.

Claiborne, a village and railroad terminal for the road to Ocean City and the seashore, is about 4½ miles east of Kent Point. The village has a permanent population of less than 100 and is of consequence only as a shipping point and gathering place for summer boarders in near-by houses.

Cox Creek, Crab Alley Bay.—Cox Creek enters Eastern Bay from the north, 2¾ miles northeast of Kent Point. Shipping, Warehouse, and Thompsons Creeks are navigable tributaries. There seems to be no direct pollution entering Cox Creek. Crab Alley Bay enters Eastern Bay just west of Cox Creek. It is over a mile wide at its entrance, but like Cox Creek is much obstructed by shoals and oyster beds.

Of the 40 samples of oysters and water taken in Eastern Bay and tributaries during January, 1915, three samples of oysters gave *B. coli* scores indicating some pollution. (See table at end of report.) The samples from bed 34, off Long Point, which gave a score of 50, and the one from bed 40, off the mouth of Shipping Creek, which gave a score of 32, were taken when the water was 3°, and 3.8° in open water away from the shore. The sample from bed 59, Crab Alley Bay, which gave a score of 32, was also taken in midwinter, the water being 3.8°. These are excellent examples of how misleading may be a decision as to the sanitary safety of shellfish, based only upon a laboratory examination of single samples of shellfish. It is probable that the pollution was due to wash consequent upon the rains. The samples of water taken at the same time do not, however, show any considerable pollution.

Kent Island Narrows, Wye River.—Kent Island Narrows is a narrow passage between Kent Island and the mainland connecting the northern arm of Eastern Bay and Chester River.

Wye River enters the eastern end of the bay. This river has several branches, the channel is narrow and crooked, and no direct pollution of consequence enters the river.

Miles River, St. Michaels.—Miles River, entering the head of Eastern Bay from the southeast, is the most important tributary and is the approach by water to St. Michaels, a small town on the west bank of the river, about 7 miles above Tilghmans Point and 14 miles above the entrance to Eastern Bay. St. Michaels has both rail and water transportation and there is a considerable trade in oysters and farm produce. There are several oyster-shucking houses located on a small cove or estuary on which are wharves and small shipyards and around which the community has been built. The town had a population of 1,517 in 1910 and does not appear to be growing, probably owing to the proximity and superior transportation facilities of Claiborne. There is no public sewerage system. A public water supply is derived from artesian wells, but there are shallow wells and the ordinary type of privies.

Typhoid fever is said to be prevalent in the summer months, though the report made to the State board of health shows few cases. Thus no cases were reported in 1908, 1910, 1911, 1912, 1913. One case was reported in August, 1909; three cases in July, one case in August, five in November, and one in December, 1914.

Oysters are said to be brought from the beds outside the cove and put overboard on beds in the cove. One tonger was noticed on the date of inspection. While the score of 2 in oysters and *B. coli* absent in 1 c. c. but present in 10 c. c. of water do not show heavy pollution, the practice of using the beds in the cove is believed to be unsafe.

CHESTER RIVER.[1]

This important river enters the eastern side of upper Chesapeake Bay, about 124 miles above Cape Charles, opposite the mouth of Magothy River and southeast of, but nearly opposite, the mouth of Patapsco River. Swan Point, on the northern side of the entrance to Chester River is a little north of east of Bodkin Point, on the southern side of the Patapsco entrance. The river is important as the approach by water to the towns of Queenstown, Centerville, Chestertown, and Crumpton, and to a number of small villages and landings which have a considerable trade in oysters and farm produce.

Jones Landing, 39 miles above the mouth, can be reached by vessels of 7 feet draft. Queenstown Creek, or Harbor, on the east bank of the river, 9 miles above its mouth, is the harbor for Queenstown, a community of 2[illegible]9 persons, from which large shipments of oysters are made. There is no public sewerage system.

Corsica River, Centerville.—Corsica River, on the east bank of Chester River, about 15 miles above Love Point Lighthouse, is the approach to the town of Centerville, which is about 5 miles above the mouth of the river. The steamboat landing is 1 mile below the town. Centerville has a population of about 1,435. The town has a high typhoid fever rate, as is shown by the following table:

Typhoid fever reported in Centerville, Queen Annes County, Md.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1908										1			1
1909			1						2	1			4
1910							2	3	11	7	4		27
1911	2	1						1	8		1		13
1912								1	4		1		6
1913				1		1	4	6	1	2		1	16
1914					1			1	3	5	2	1	13
1915		1											1
Total	2	2	1	1	1	1	6	12	29	16	8	2	81

Cases in county	355
Population of county	16,839
Cases in Centerville	81
Population of Centerville	1,435

The periodicity of the disease points to a generally insanitary condition, and "food, fingers, and flies," rather than to water alone, as the causative factors.

Love Point.—Love Point is a long tongue of land, which is on the south side of the entrance of the Chester River from Chesapeake

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[1] See maps Nos. 5 and 7.

Bay, and is a railroad terminal with a large wharf for steamboats. There are few residents in the neighborhood.

Chestertown.—Chestertown, the county seat of Kent County, is a thriving town on the west bank of the river, about 26 miles above Love Point Lighthouse. The town had a population of 2,735 in 1910 and has about 3,500 now. There is a public sewerage system, to which about 60 per cent of the houses are said to be connected. The sewage is discharged untreated into Chester River. The public water supply is derived from a gang of deep wells in a bottom on the outskirts of the town. At the time of inspection, March, 1915, wells were being equipped several hundred yards farther down the hollow and it is understood that the pumping station will be moved. Ordinary privies are numerous and it is probable that a material reduction in the morbidity rate would follow enforced sewer connections or the introduction of a sanitary type of privy.

Typhoid fever reported in Chestertown, Md.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1908								6	3	3			12
1909						1	29	6	2	13	3		54
1910	1							2	2	1		1	7
1911				1				6	5	1	1	1	15
1912								1	2	6	6	1	16
1913						1		4		1			6
1914										1		2	3
1915			1										1
Total	1		1	1		2	29	25	14	26	10	5	114

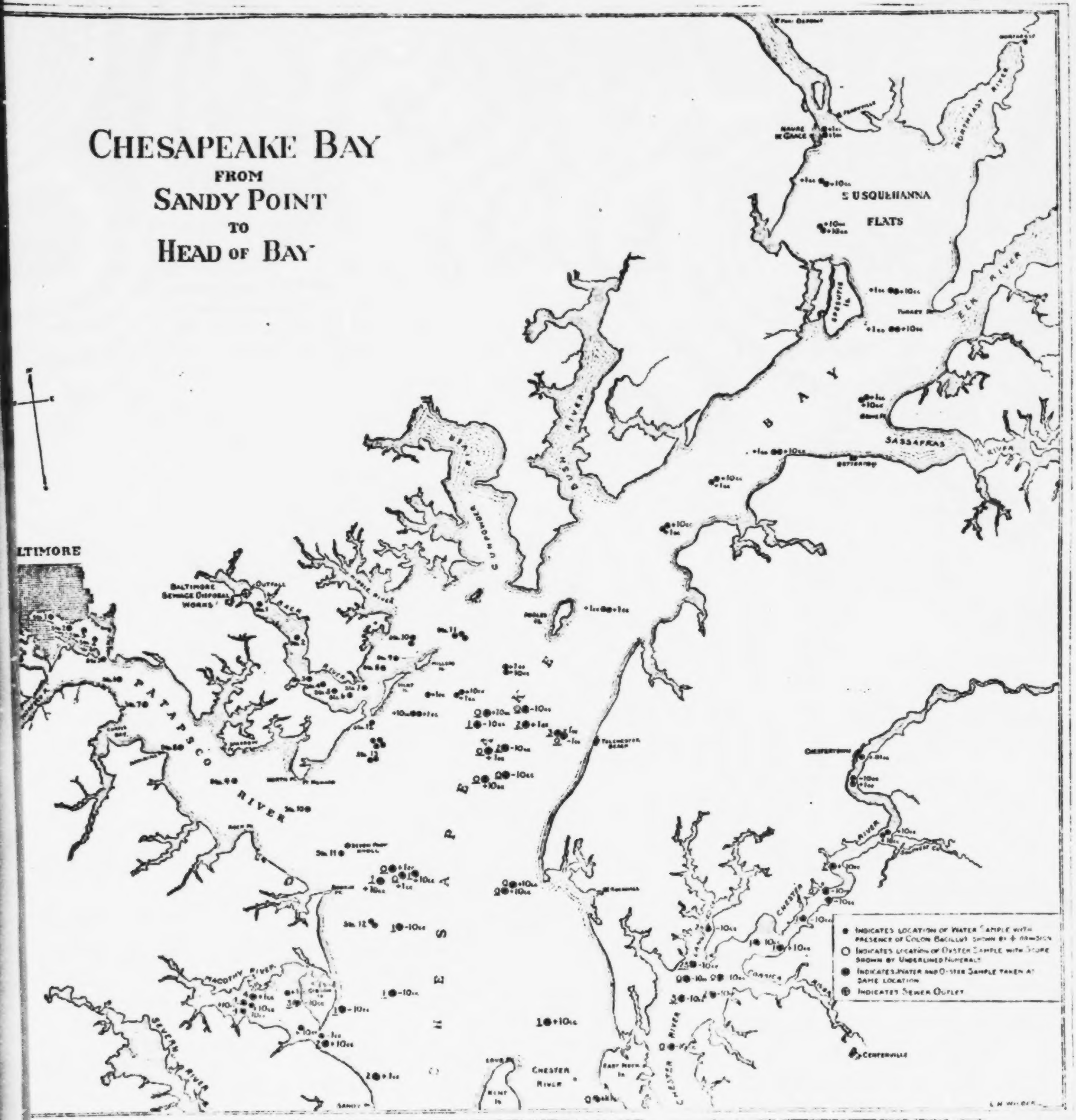
Cases in county	335
Population of county	16,957
Cases in Chestertown	114
Population of Chestertown	2,735

The bacteriological examination of river water (January, 1915), showed *B. coli* present in 0.01 c. c. at Chestertown; the nearest oyster beds, however, are between Primrose Point and Jarretts Creek, 6 or 7 miles below the town, and the highest content in that section was *B. coli* present in 10 c. c. The total amount of direct sewage discharged into Chester River is inconsiderable compared with the volume of the water in the river.

Nearly the entire bottom of the lower river is composed of oyster beds, and large quantities of oysters are caught and shipped from this area. In view of the importance of the area, therefore, and the relative positions of the Chester and Patapsco Rivers, it is pertinent to inquire into the chance for pollution from the latter river reaching the beds at the mouth of the Chester River. Ebb tide at Seven Foot Knoll continues about an hour after the flood sets into the Chester; if the intervening waters of the bay channel were passive and quiescent there would be such opportunity. The tide, however, in

MAP No 7

50a


CHESAPEAKE BAY
FROM
SANDY POINT
TO
HEAD OF BAY
SUSQUEHANNA
FLATS
HAVRE DE GRACE
NORTHEAST RIVER
ELK RIVER
SASSAFRAS RIVER
BAY
GUNPOWDER
BUSH RIVER
LTIMORE
BALTIMORE SEWAGE DISPOSAL WORKS
OUTFALL
BACK RIVER
MIDDLE RIVER
PATAPSCO RIVER
CHESAPEAKE
TOLCHESTER BEACH
CHESTERTOWN
CHESTER RIVER
CORSICA RIVER
CENTERVILLE
MAGOTHY RIVER
SEVERN RIVER
KENT IS.
EAST NECK IS.
● INDICATES LOCATION OF WATER SAMPLE WITH PRESENCE OF COLON BACILLUS SHOWN BY + OR − SIGN
○ INDICATES LOCATION OF OYSTER SAMPLE WITH SCORE SHOWN BY UNDERLINED NUMERALS
● INDICATES WATER AND OYSTER SAMPLE TAKEN AT SAME LOCATION
⊕ INDICATES SEWER OUTLET

U.S. PUBLIC HEALTH SERVICE

the channel at this time is running upward and no such danger exists. The examinations of oysters and water from this important area show good sanitary conditions. (See table.)

ABOVE CHESTER RIVER.

The only tributaries entering Chesapeake Bay from the Eastern Shore above Chester River are the Sassafras, Bohemia, and Elk Rivers, and Back Creek, at the head of which is the western entrance to the Chesapeake and Delaware Canal. Northeast River enters the head of Chesapeake Bay. No considerable direct pollution enters the bay from these rivers, except possibly from Northeast and Elk, and no shellfish grow in or near them.

Tolchester Beach is a popular summer resort on the Eastern Shore nearly opposite the upper oyster beds, but the population during the oyster season, according to the census of 1910, was only 20.

CONCLUSIONS.

The following conclusions are to be made concerning the "Bay Side" of the Eastern Shore:

1. No oysters are planted in Little Annemessex River, a tributary of Tangier Sound; but to the east of Crisfield, which is located 2 miles above the mouth of the river, is a wide pond in which oysters are sometimes kept. The taking of oysters from this lagoon should be forbidden.

2. Although there was evidence of heavy pollution in the harbor of Cambridge on the Choptank River, no oyster beds are in the harbor, and at the time of inspection, there were no signs of oysters being floated in the harbor. Immediately outside the harbor entrance, however, there are oyster beds. While the dilution of the sewage is very great in the river, the amount is sufficient to constitute a danger from oysters taken within a considerable distance of the sewer outlets. The Maryland department of health has undertaken a comprehensive sewerage system, which will not only increase the healthfulness of the town, but will remove the danger of infectious pollution from valuable and extensive oyster beds.

3. With one exception, all of the tributaries of the Choptank River having oyster beds may be considered safe. They do not furnish any dangerous pollution to the Choptank. The exception is Town Creek, which enters the Tred Avon at Oxford. No oysters should be taken from this creek. Although it would appear, on the basis of one examination, that no serious pollution reaches the oyster beds of the Tred Avon from the Easton sewage disposal system and similar points, a further study of the upper beds of the river should be made.

4. Other beds in the tributaries entering Chesapeake Bay from the east may be considered safe for the production of oysters.

"WESTERN SHORE."

SUSQUEHANNA RIVER.[1]

This is the first tributary to enter Chesapeake Bay and the largest river discharging into it. This great stream has a drainage area of 24,000 square miles in the States of Pennsylvania and New York, with a mean annual discharge of 28,500 second feet, varying from a maximum of 325,000 in March to a minimum of 3,570 in August (Water Supply Paper 281, U. S. Geological Survey, 1912). The total population living on the watershed is about 2,812,000, of whom approximately 395,000 are in New York, 17,000 in Maryland, and 2,400,000 in Pennsylvania. The aggregate amount of pollution, both domestic and industrial, received along its course is very great.

Havre de Grace is a town with a population of 4,212 on the western bank at the entrance of the river. There is a public sewerage system, from which the sewage is discharged untreated into the river, and a public water supply pumped from the Susquehanna River and treated in a mechanical filter before delivery. Port Deposit, with a population of 1,394, and Perryville, with a population of 635, are communities on the east bank of the river just above its entrance.

The nearest cities of large size which contribute sewage to the river are Harrisburg, with a population of 64,186; Steelton, with a population of 14,246; Columbia with 11,864, Lancaster with a population of 47,227, and York with a population of 44,750.

Harrisburg is on the Susquehanna River about 80 miles above its mouth and Steelton a few miles farther down. Columbia is on the same river, 40 miles from Havre de Grace. Lancaster is on the Conestoga, 15 or 20 miles above its junction with the Susquehanna, about 35 miles above its mouth. York is on the Codorus, a few miles above its entrance into the Susquehanna, and about 55 miles above Havre de Grace.

The Susquehanna River from Harrisburg to Port Deposit, the head of navigation, consists of a series of rapids. The great dam at McCalls Ferry probably serves as a settling basin for much of the suspended matter from above.

Nature of Susquehanna as purification factor.—The river is about 1 mile wide at its mouth, debouching abruptly into a quadrilateral area approximately 5 to 6 miles wide; about 6 miles below the entrance to the river the shores again approach each other so that Sandy Point and Turkey Point are only 2¼ miles apart. In consequence of the water suddenly emerging from the narrow river into this wide area, there is a great slackening of the current, and this factor, together with the presence doubtless of some sea water, has resulted in the deposit of silt and the formation of great areas of flats. There is a considerable growth of aquatic plants on these flats and on the flats to the north side of the bay channel; and from them come both free oxygen and those forms of organic matter suitable for food for the oyster.[1]

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[1] See maps No. 1 and No. 7.

While the principal sources of pollution of the Susquehanna are quite distant, and most of it is disposed of by sedimentation and by time, biological, and chemical factors it is evident from the samples taken that considerable pollution is present in the river and in that portion of the bay nearest it, at least during periods of heavy stream flow. Of 20 samples of water taken between Havre de Grace and Pooles Island, all contained *B. coli* in 10 c. c., and 11 in 1. c. c. It is believed, however, that this pollution constitutes no danger to shellfish beds.

Beds near Pooles Island.—The uppermost beds in Chesapeake Bay are about Pooles Island, which is about 20 miles below the mouth of the Susquehanna River; 4 miles from the upper mouth of Back River, and 12 miles from Patapsco River. The waters of this region from Pooles Island down to the middle grounds opposite the Patapsco are similar to those in the Potomac between Cedar Point and Popes Creek, those in the James above White Shoals, and those in the Rappahannock River about Bowlers' Rock. Under favorable conditions of stream flow and salinity, oysters propagate and grow very rapidly, but unfavorable conditions occur frequently enough to prevent the growth of old and large oysters; as a consequence the oysters from this region are used for seed purposes, or, during favorable seasons, for steaming and canning. The sanitary conditions found in this area are discussed in connection with the Patapsco and Back rivers. (See page 59.)

BACK RIVER AND BALTIMORE SEWAGE EFFLUENT.

Between the Susquehanna and Patapsco rivers, the Bush, Gunpowder, Middle, and Back Rivers discharge into the Bay from the west. Many gun clubs and summer residences have been built on the shores of these streams, and there are several summer resorts on the shores of the bay. No considerable sewage, however, enters the bay from any of these sources except from Back River, into which is discharged the effluent from the Baltimore sewage disposal plant.

Back River enters Chesapeake Bay about 3 miles above North Point at the entrance to Patapsco River, and runs northwestward for about 8 to 9 miles. The river is shallow throughout, though 8 feet draft can be carried for about 3 miles or less, and it varies in width from three-fourths to 1 mile except near the head and at a narrow section opposite Todd Point, where it narrows to one-half mile. Hart Island lies immediately in front of the entrance; hence there are two openings, the one on the west being only about 1,000 feet wide and from 2 to 4 feet in depth. The larger opening is over a mile wide, the river changing its direction at Rock Point from southeast to northeast and emptying into Hawk Cove. The relative sizes and depths of the two entrances make it evident that most of the ebb flow is through the latter entrance.

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[1] See Report on Potomac River, Hyg. Lab. Bull. 104.

The river has a small watershed and there are a few small resorts and residences along its shore. The importance of the estuary from one standpoint lies in the fact that into it, about 6 miles above the entrance, is discharged the final effluent from the great sewage disposal plant of the city of Baltimore. This plant is a part of the general plan to relieve the Patapsco River and Baltimore Harbor by constructing a modern sewerage system with a disposal plant discharging the effluent elsewhere. The following description was written by Sanitary Engineer Leslie C. Frank:

> The Baltimore sewage treatment plant was designed and constructed in three main stages. The first stage was designed in 1906. The design represented the best practice in the art of sewage treatment at that time. This first stage consists of preliminary coarse screen chambers designed to serve 1,000,000 people; a meter house with five 42 by 21-inch Venturi meters; three preliminary, plain sedimentation tanks, each of 3,300,000 gallons working capacity; three preliminary sludge digestion tanks, each of [illegible]16,000 cubic feet capacity; a single sludge bed 100 by 400 feet in area; a sprinkling filter control house; 12 acres of sprinkling filters, each acre serving 20,000 people; two final settling basins to serve 600,000 people; a hydroelectric powerhouse, generating power from available head in the treated sewage, and a final effluent conduit discharging into Back River.
>
> The second stage was designed in 1912 and consists of 18 additional acres of sprinkling filters, modified from the original design for increased construction and operation efficiency. These 18 acres of sprinkling filters serve an additional population of 360,000 people and increase the total sprinkling filter capacity to 600,000 people.
>
> The third stage was designed in 1913 by Sanitary Engineer Leslie C. Frank of this service and increased the preliminary sedimentation and sludge digestion capacity to 600,000 people, at the same time taking advantage of appreciable advances in the art of sewage treatment which had been made subsequent to 1906. This third stage includes twenty-eight 40-foot diameter Imhoff tanks, sixteen 40-foot diameter separate sludge digestion tanks, both types of tank being about 25 feet deep, and 260,000 square feet of sludge drying beds.
>
> The preliminary coarse screens are cleaned by hand rakes, and screenings are accumulated and dried on the ground surface. The procedure adopted in operating the preliminary sedimentation tanks is to keep a given tank in operation until it shows signs of undesirable septic action. Then the supernatant liquid is pumped off into one of the other tanks and the residual sludge pumped into one or more of the three preliminary sludge tanks. The emptying and cleaning operation consumes at present somewhat less than a week per tank per cleaning.
>
> The operation of the present three sludge digestion tanks has not as yet proceeded to a stage where it is possible to state with finality the degree of satisfaction they will

eventually afford. The sludge in them possesses the normal characteristic odor of properly digested sludge (faintly like warm sealing wax) but often shows a rather high moisture content and dries somewhat slowly. On the whole, however, the results obtained with the separate sludge digestion tanks at Baltimore are decidedly gratifying.

The Imhoff tanks, cylindrical sludge digestion tanks, and sludge drying beds designed as the third stage are now practically completed so that in the near future part of the raw sewage after passing the coarse screens will pass through the Imhoff tanks and the rest through the plain sedimentation tanks. The subsequent operation schedule will be similar to that obtaining at present. The effluent from the plain sedimentation tanks will pass through fine-mesh screens and the combined flow from the Imhoff tanks and plain sedimentation tanks will then be applied to the sprinkling filters, the sprinkling filter effluent passing through final settling tanks and thence through the hydroelectric powerhouse into the main outlet conduit.

The sewage flow at the treatment plant is expected to amount to about 75,000,000 gallons per day from the 600,000 population above referred to. A considerable portion of the total population of Baltimore has already been provided with sewer connection, and within a year or two the remaining portion will be likewise provided.

The tidal current in the river is very slow and a large deposit of solids is present, from the outfall down. There is a gradual change on the bottom, from liquid through suspended matter to a light deposit of considerable depth over the natural bed of the estuary.

Two inspections with the collection of 13 samples of water were made by the Bureau of Chemistry on February 5 and April 10, 1914; one inspection was made June 27, 1914, by the Public Health Service and Bureau of Chemistry, at which time seven samples were taken, and subsequently samples were taken February 25, 1915, by this service.

There is a considerable odor and discoloration to the water in the neighborhood of a line between Cox Point and Weatherby Point near the outfall and these decrease as the stream is descended. The following results were obtained from samples collected at the above described line (station 1, map 7):

Results obtained from samples collected at station 1.

[Bacteria per c. c.]

Date.	Tide.	Temperature of water.	Total count on agar 37°.	Gas formers in—	B. coli confirmed in—	Dissolved oxygen.	
						Mgs. per liter.	Percentage saturation.
1914.		°		c. c.	c. c.		
Feb. 5	Flood.	6.2	1,560	0.1	0.1	7.42	61.02
Apr. 10	Ebb.	9.8	80,060	.001	.001	8.10	72.00
June 27	Flood.	27.5	285,000	.0001	.0001	4.28	53.77

These results contrast sharply with those obtained from the station between Rocky and Creekhold Points, 5½ miles farther down. (Station 7 on map 7.)

Results obtained from samples collected at Station 7.

[Bacteria per c. c.]

Date.	Tide.	Temperature of water.	Total count on agar 37°.	Gas formers in—	*B. coli* confined in—	Dissolved oxygen.	
						Mgs. per liter.	Percentage saturation.
1914.		°		c. c.	c. c.		
Feb. 5	Flood	4.2	580	0.1	−0.1	11.60	90.98
Apr. 10	Ebb	8.8	4,200	−0.1	−0.1	10.53	91.72
June 27	do	28.7	95	−0.01	−0.01	7.48	97.66
1915.							
Feb. 23	do	0.5	400	+0.1	+0.1	....	....

Samples taken near the mouth of the gap between Millers and Hart Islands (Station 12) showed *B. coli* in one instance present in 1 c. c., with a 37° count of 820; and at two other times *B. coli* absent in 0.1 and in 0.01 c. c. quantities, with 37° counts of 1,300 and 125. Combining all samples taken in the Back River and immediately outside the entrances, there were: Of 36 samples, 9 negative for *B. coli* in the largest quantities used, these being 1 c. c. or less; 27 or 100 per cent of the remainder showed *B. coli* present in 10 c. c. quantities; 26 out of 36, or 72 per cent, showed *B. coli* in 1 c. c.; 8 samples, or 22 per cent, in 0.1 c. c.; 3, or 8.3 per cent, in 0.01 c. c.; 2, or 6 per cent, in 0.001 quantities, while one showed *B. coli* in 0.0001 c. c.

By stations down the river from the outfall the results were as follows, the last station being 1½ miles outside of Hart Island and not fairly attributable to Back River alone:

Station No. 1.—3 water samples; 3+in 0.1; 3+in 0.01; 2+in 0.001; 1+in 0.0001 c. c.
No. 2.—3 water samples; 3+in 0.1 c. c.
No. 3.—3 water samples; 2+in 10; 1+in 1; 1−in 0.1 c. c.
No. 4.—1 water sample; 1−in 0.1 c. c.
No. 5.—2 water samples; 2+in 1 c. c.
No. 6.—1 water sample; 1+in 1 c. c.
No. 7.—6 water samples; 5+in 1; 1+in 0.1; 1−in 0.1 c. c.
No. 8.—1 water sample; 1−in 0.1 c. c.
No. 9.—3 water samples; 2+in 1; 1−in 1 c. c.
No. 10.—2 water samples; 2−in 1 c. c.
No. 11.—3 water samples; 3+in 1; 1+in 0.1 c. c.
No. 12.—3 water samples; 2+in 0.01; 1−in 1 c. c.
No. 13.—5 water samples; 4+in 10; 2+in 1; 1−in 0.1 c. c.

It is not believed that the improvements now under construction will lessen materially the amount of pollution discharged from Back River into Chesapeake Bay because of the increased burden as the amount of sewage is increased.

In view of the environments and laboratory findings, shellfish from the immediate vicinity of the entrances to Back River are to be considered unsafe for consumption as food. This is especially true of clams and oysters gathered during the summer months along the foreshore. The result of investigations of the flats in general is discussed in connection with Patapsco River.

PATAPSCO RIVER AND BALTIMORE HARBOR.[1]

The Patapsco River discharges into Chesapeake Bay from the northwest, 140 miles above Cape Henry Lighthouse. Between Bodkin and North Points, the southern and northern points at its entrance, the river is about 3¾ miles wide; this width gradually decreases, and at Fort Carroll, 6½ miles above Bodkin Point, it is about 1¾ miles wide; the river again widens and then contracts until abreast of Fort McHenry, east of which is Baltimore Harbor. The river turns westward at Fort McHenry, and 1½ miles farther up is crossed by a drawbridge through which Middle Branch is entered. Curtis Creek is an important tributary; its entrance, Curtis Bay, is in the western bank 1¾ miles above Fort Carroll and has a general depth of 25 feet. There are many wharves along the creek, and at the head of the bay at South Baltimore are the railroad pier and coal pockets of a branch of the Baltimore & Ohio Railroad. The United States Coast Guard Depot is on Arundel Cove 1½ miles up the creek. There are eight or nine other, but unimportant tributary creeks, in which, however, no oysters are grown, and the pollution by them is inconsiderable compared with that from Baltimore Harbor.

Baltimore Harbor makes northward between Lazaretto Point on the east and Fort McHenry, 500 yards distant, on the west. Above this line it has a width of 850 yards to Fells Point, where it narrows to 400 yards. Its width gradually decreases to the head of the harbor, which is about 2½ miles above Fort McHenry. The upper end above the City Dock is called "The Basin" or "The Hole."

Population and industries of Baltimore.—The city of Baltimore, situated around the harbor and on the shores of Patapsco River, has a very large foreign and coasting trade, is one of the great coaling ports of the world, and is the principal market for the farm produce and oysters from Chesapeake Bay and its many tributaries. Baltimore is thought to be the first city in which oysters were opened and canned for shipment and is now perhaps the greatest oyster market and distributing center in the country. In 1910 the population was 558,485, and the city limits included an area of 30 square miles. The present population approximates 600,000.

Baltimore sewage problem and solution.—Until within a few years ago Baltimore was perhaps the most backward city of her size in this country in the disposal of her sewage. Slop and drain water ran from houses to the gutters to find its way into sewer openings. Jones Falls, a rapidly flowing stream which runs through the center of the city, received a large part of the sewage from outfalls distributed along its course, and conditions were offensive and dangerous, relief coming only when floods swept the stream and low-lying parts of the city. Jones Falls discharges into the Basin near the City Dock and the odors from the waters of that small and almost tideless basin were almost intolerable as they were agitated by vessels. A few hours were sufficient to darken vessels painted with white lead, so large an amount of hydrogen sulphide was present, and no fish life except eels existed in the water.

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[1] See map No. 7.

About 1906 a large bond issue provided funds for a complete modern sewerage system, the construction of which began about 1910. This system already includes the present great disposal plant on Back River and the construction of a concrete thoroughfare over the confined waters of Jones Falls. The reconstruction of the whole sewerage system is well under way and in a year or two the whole city population will have been connected with the system.

The objects to be attained are the relief of the harbor and river from excessive pollution, the construction of a complete sewerage system, and the disposal of the sewage in Back River, after treatment which will prevent the effluent from carrying infectious pollution to the oyster beds in the upper bay. In studying the results obtained in the present investigation, it should be remembered that conditions in both Patapsco and Back Rivers, and consequently in the neighboring waters of Chesapeake Bay, are still in a state of transition.

Tides and currents.—The mean range of tides in Baltimore Harbor is about 1 foot. Observations made by the United States Coast and Geodetic Survey show the following velocity of tides:

Velocity of tides in Baltimore Harbor.

	Velocity per hour.		Date.	Period of observation.
	Flood.	Ebb.		
	Knots.	*Knots.*		*Days.*
100 yards off Fort McHenry	0.1	0.08	January to June, 1903	25
550 yards S. 7° W. Ft. Howard Light	.2	.30	May 28 to 29, 1867	1
At Black Can Buoy 19½, edge of channel between North Point and Rock Point.	6	.40	May 30, 1867	½
1,100 yards S. 43° W. Rock Point	.3	.40	May 31-June 4, 1867	2
At Light Buoy 1 B on channel mile below 19½	.8	1.00	June 5, 1867	¼
245 yards N. of Red. Spar. 8 B (about 3 miles below buoy 1 B).	.6	.5	June 7 to 25, 1867	14

The above results show the almost currentless condition of the basin, even at its entrance 1¾ miles or more below Jones Falls, the principal source of pollution. Calculating the duration of one ebb tide as about six hours, the movement during that period would be only about 2.70 miles before a flood tide of nearly equal velocity and duration would tend to return the polluted water. Thus, practically, it is only by slow diffusion that pollution from these sources reaches the lower waters. The average tidal velocities, from the basin to about 3 miles below the entrance to the Patapsco River, are about 0.43 knot for flood tide and 0.45 knot for ebb tide, or an ebb excess each 24 hours of only 2.4 nautical miles.

Observations taken between the mouth of the Patapsco and the lower opening into Back River are as follows:

	Flood.	Ebb.	Date.	Duration of observation.
				Days.
1¾ miles S. 23° W. Hart Island Light	0.15	0.23	Apr. 28 to May 7, 1907.	1½
2¼ miles S. 25° W. Hart Island Light	0.50	0.03	May 27, 1907	½
450 yards W. Hart Island Lower Range	0.60	0.10	June 4, 1907	½

A comparison of the relative times of high and low water (Tide Tables, U. S. C. and G. Survey) shows that high water occurs 48 minutes, and low water 36 minutes, later at Rocky Point near the entrance to Back River than at North Point at the entrance to Patapsco River.

Bacteriological samples.—Eighty-three samples of water were taken in the channel of Patapsco River; of these 63 showed *B. coli* present in 10 c. c. quantities. The remaining 20 were negative in high dilutions and were not worked in 10 c. c. quantities; 8 samples were positive in 10 c. c. but absent in 1 c. c.; 55 samples showed *B. coli* in 1 c. c.; 33 showed *B. coli* in 0.1 c. c. quantities; 13 in 0.01 and 1 in 0.001 c. c. In percentages, 100 per cent of those worked in 10 c. c. quantities were positive for *B. coli;* of 83 samples 66 per cent contained *B. coli* in 1 c. c. quantities; 40 per cent in 0.1 c. c. quantities, and 16 per cent in 0.01 c. c. quantities.

The following results obtained by the Bureau of Chemistry, Department of Agriculture, show the marked deficiency of oxygen at the outlet of the basin, the influence of temperature upon the efficiency and the recovery to normal as the river is descended.

Results obtained by Bureau of Chemistry at outlet of basin.

Sampling station.	Date collected.	Temperature of water.	Tide	*B. coli.* in—	Total count on agar 37°	Dissolved oxygen.		
						Required.	Mgs. per liter.	Percent saturation.
		°		*c. c.*				
Between Lazaretto Point and Fort McHenry.	[1] Feb. 6	3.8	Ebb..	1	1,000	3.9	9.58	75.97
Do	[1] Mar 13	1.2	Flood.	1	68	6.4	11.27	85.44
Do	Apr. 10	8.8	...do..	.1	1,800	4.5	10.28	90.49
Do	June 26	25.3	Ebb..	.01	2,750	6.1	2.58	32.25
Off Sparrows Point	[1] Feb. 6	3.8	...do..	1	2,300	3.1	10.67	82.84
Spar buoy 28	[1] Mar. 13	1.2	Flood.	10	50	4.2	12.63	95.90
Do	Apr. 10	8.6	...do..	— .1	600	3.9	10.99	95.65
Do	June 26	25.8	Ebb..	— 1	125	4.1	6.96	87.65
Intersection of old and new channels	[1] Feb. 6	2.6	...do..	1	14,600	2.9	12.22	91.74
At spar buoys	[1] Mar. 13	1.2	Flood.	—10	36	4.5	12.80	96.60
Do	Apr. 10	8.4	...do..	.1	900	3.7	11.30	96.99
Do	June 26	25	Ebb..	— 1	80	4.2	5.82	72.57

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[1] The samples for bacteriological examinations collected in February and March were sent to the Hygienic Laboratory, and owing to delay in receiving them, not much importance should be attached to those results.

Results at stations in Patapsco River.[1]

Station No. 1.—Upper end of basin; 2 water samples; 2+ in 0.1 c. c.
2.—Below Jones Falls; 5 water samples; 5+ in 0.1, 2+ in 0.01, 1+ in 0.001 c. c.
3.—Off Locust point; 1 water sample; 1+ in 0.01 c. c.
4.—Off B. & O. pier above Fort McHenry; 3 water samples; 3+ in 0.01, 1+ in 0.001 c. c.
5.—Off Lazaretto Point; 11 water samples; 9+ in 1, 7+ in 0.1, 3+ in 0.01 c. c., 2− in 1 c. c.
6.—Seven-eighths mile below No. 5; 5 water samples; 5+ in 1, 4+ in 0.1, 2+ in 0.01 c. c.
7.—One and one-half miles below No. 6, opposite Fishing Point; 10 water samples; 9+ in 10, 8+ in 1, 5+ in 0.1, 2+ in 0.01, 1− in 1 c. c.
8.—Off Fort Carroll; 12 water samples; 10+ in 10, 8+ in 1, 2+ in 0.1, 2− in 0.1 c. c.
9.—Two miles below No. 8, off Sparrow Point; 11 water samples; 8+ in 10, 6+ in 1, 1+ in 0.1, 3− in 0.1 c. c.
10.—Two and one-half miles below No. 9 off Bar at entrance to river; 17 water samples; 8+ in 10, 6+in 1, 3+ in 0.1, 9− in 1 c. c.
11.—Seven Foot Knoll, 2 miles below No. 10; 6 water samples; 3+ in 10, 2+ in 1, 3− in 1 c. c.

The gradual and constant decrease in amount of pollution from the basin downward is only partly due to dilution by flood waters from the bay; for, as is shown by the above tidal data, the time factor is of very considerable importance, and the death rate of intestinal organisms must be very great.

The flats between Pooles Island, the upper bay channel, and the entrance to Patapsco River probably receive all of their pollution from the Patapsco and Back Rivers. Of five samples of water taken in the neighborhood of Station 13, four were positive in 10 c. c., two in 1 c. c., and one was negative in 0.1 c. c.

Of the 31 samples of water from all over this area 4, or 13 per cent, showed *B. coli* absent in 10 c. c. quantities; 7, or 22.5 per cent, present in 10 c. c. but not in 1 c. c. quantities; 22, or 71 per cent, present in 10 c. c.; 13, or 42 per cent, present in 1 c. c.; 1 near the entrance off North Point showed *B. coli* present in 0.1 c. c., and 1 each was negative in 1 and 0.1 c. c., respectively.

Oyster beds.—So far as could be ascertained by inquiry and from the official map of oyster areas of the State of Maryland, no oysters are grown or floated in Patapsco or Back Rivers, except a small lump off Sparrows Point. There is a small area (bed No. 3, Baltimore County) situated on the middle ground or flats above described. This area is about 3 miles southeast of North Point, at the entrance to Patapsco, and the same distance to the south from the small entrance to Back River. A sample of oysters taken from the area on February 5 by representatives of the Bureau of Chemistry and shipped to the Hygienic Laboratory scored 32, with a bacterial count on agar at 20° of 122,000. While this is not a very high score, it is probably more than they would have scored had they been examined at once instead of after a delay of five days in shipment. A large bed containing several hundred acres lies on a middle ground between a swash channel, which runs downward from near Pooles Island to near the Middle Ground Light, and the main channel of the bay (bed No. 1, Baltimore County and No. 6, Kent County). Of 11 samples of oysters taken on these beds, one which was taken under the same conditions and subject to the same delay as the sample just discussed, scored 41, with a total count at 20° of 510,000; no water sample is recorded with it. Of the 10 other samples taken and worked soon afterwards, 5 scored 0, with 2 samples of water taken with them showing *B. coli* absent in 10 c. c.; 2 were positive for *B. coli* in 1 c. c., and 1 negative for *B. coli* in 1 c. c. quantities.

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[1] See map of Chesapeake Bay, Sandy Point to head of bay.

To the west of the dredged channel to Patapsco River there is a small bed just off Bodkin Point. No oysters were taken from this area, but station No. 11, Patapsco River (see map), is in that immediate vicinity. Of six samples of water taken there, three were positive for *B. coli* in 10 c. c., two positive in 1 c. c., and three were negative in 1 c. c. quantities.

Between the Craighill dredged channel on the west and the main channel up the bay, from Seven Foot Knoll opposite the entrance to Patapsco River, clear down to opposite the entrance to the Magothy River, there is a large and productive area (bed No. 3, Anne Arundel County). This area must receive water from Patapsco and Back Rivers and from Susquehanna River and the upper bay; yet of the four samples each of oysters and water taken in that area, two samples of oysters scored 1 each, with the corresponding water sample showing *B. coli* present in 10 c. c. but not in 1 c. c., and two samples scored 0, with corresponding samples of water each showing *B. coli* present in 1 c. c. quantities.

In the whole area of Chesapeake Bay west of the main channel, north of Magothy River, and outside the entrances to the Patapsco River, but including stations 10, 11, and 12 immediately adjacent to those entrances, of 59 samples of water examined bacteriologically 24 were negative in the largest dilutions used, less than 10 c. c. Of the other 35, 7 samples, or 20 per cent, showed *B. coli* absent in 10 c. c. quantities; 12, or 34 per cent, were positive in 10 c. c. but not in 1 c. c.; 36, or 61 per cent, contained *B. coli* in 10 c. c. or less quantities; 24, or 41 per cent, *B. coli* positive in 1 c. c. or less quantities; 30, or 51 per cent, *B. coli* absent in 1 c. c. quantities; 4, or 7 per cent, present in 0.1 c. c. All of the samples positive in 0.1 c. c. were from near the rivers.

Summary.—In general it may be said that—

The waters of Patapsco and Back Rivers are grossly polluted by sewage from the city of Baltimore.

The currents in both rivers are very slow and the time between the discharge of the sewage from the lowest outfalls and the nearest shellfish beds is an important factor.

The dilution upon reaching the waters of Chesapeake Bay is enormous.

The examination of samples of water and of shellfish over the area most subject to pollution from the above sources indicates that, in the light of present knowledge, the pollution which reaches the area is insufficient to constitute any considerable danger of conveying infectious disease.

In view of the changing conditions in these waters and the importance of the shellfish industry a study of the areas should be continued for a considerable time.

The growing of shellfish for food purposes in the above rivers or the foreshores and the taking of shellfish in immediate proximity to summer resorts during the time they are open should be prohibited by competent authority.

MAGOTHY RIVER.[1]

Magothy River empties into the western side of Chesapeake Bay, about 134 miles above Cape Henry and 5 miles below Bodkin Point. The river entrance between Mountain Point and Persimmon Point is nearly one-half mile wide, but shoals extend from each point, leaving a narrow channel. Immediately inside of the narrow entrance the river becomes from 1 to 1½ miles wide and a draft of 8 feet can be carried about 6½ miles up the river. A cove or creek on each side further increases the width and capacity of the river. The southern end of the dredged ship channel to Baltimore is just opposite, and about two miles off the entrance to Magothy River. This fact and the fact that Sandy Point on the south extends 1½ to 2 miles farther east than Bodkin Point have led some investigators to the opinion that the sewage-polluted water from Baltimore harbor is deflected and carried into the river. The Tide Tables of the Coast and Geodetic Survey show that low water occurs 18 minutes and high water 19 minutes later at Persimmon Point (mouth of Magothy River) than at Sandy Point; no current would enter therefore during ebb tide. The earlier set of flood tide along the shore would seem to give 19 minutes during which the water would travel from the channel toward the mouth of Magothy; but as the current, even in the channel, is not over 0.63 knot an hour there is an opportunity for very high dilution with bay water before any of the Baltimore harbor water could enter Magothy River.

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[1] See map No. 7.

That the harbor water does somewhat affect the chemical contents in the bight above Sandy Point, off the entrance to Magothy, is shown by the results obtained from samples taken by the Bureau of Chemistry. Samples of oysters and water taken inside the river in February, March, June, and September showed a little increase in *B. coli* content over those taken outside the river, but no dangerous pollution. No communities discharged sewage into the river.

SEVERN RIVER AND ANNAPOLIS HARBOR.[1]

Severn River enters the western side of Chesapeake Bay about 128 miles above Cape Henry and 12 miles below the Patapsco. For a distance of 5½ miles above Greenbury Point at its mouth it has an average width of three-eighths mile; it then broadens into what is known as Round Bay. This bay is about 1 mile broad, 2 miles long, and has an average depth of 19 to 23 feet.

Annapolis and Naval Academy.—Annapolis, the capital of Maryland, and the United States Naval Academy are on the southwestern bank of the river about 1½ miles above its mouth. There is a dredged channel 30 feet deep and 180 feet wide from deep water in Chesapeake Bay to the United States Naval Academy. The river extends only a few miles above Annapolis, which, with its suburbs and the Academy, is the source of the only considerable pollution.

Several creeks enter the river on its southwestern side. Of these, Back Creek enters below the city, between Chinks Point and Horn Point. College Creek is on the north side and Spa Creek on the south side of a peninsula on which are the main portions of Annapolis and the Academy. A bridge across Spa Creek connects the city with Eastport, a suburb which has been built on Horn Point. A bridge across College Creek connects the Naval Academy with the Naval Hospital and the United States Marine Barracks.

The population of Annapolis in 1910 was 8,609, and that of Eastport was 600. The present population of the Naval Academy Reservation is 1,733. In addition there are 736 civilian employees who work on the reservation in the day time; 153 officers reside in Annapolis, but perform duties on the reservation during the day.

The water supply of Annapolis is described as follows:

> The water supply of the city is furnished by a corporation, whose stock is owned by the city. There are two public wells, one semipublic well, and five private wells from which water is being taken for drinking purposes; the public water supply, however, is generally used, there being 2,261 service connections. The source of the public supply is a watershed of approximately 2,000 acres, upon which live 22 families and across which, for about 2 miles, are the tracks of the Washington, Baltimore & Annapolis Railroad Co. About 600 acres of the watershed are owned by the company. None of the watershed is patrolled.
>
> The water has been examined by the State board of health a number of times and *B. coli* have been found present in 0.1 c. c. quantities in practically every instance.

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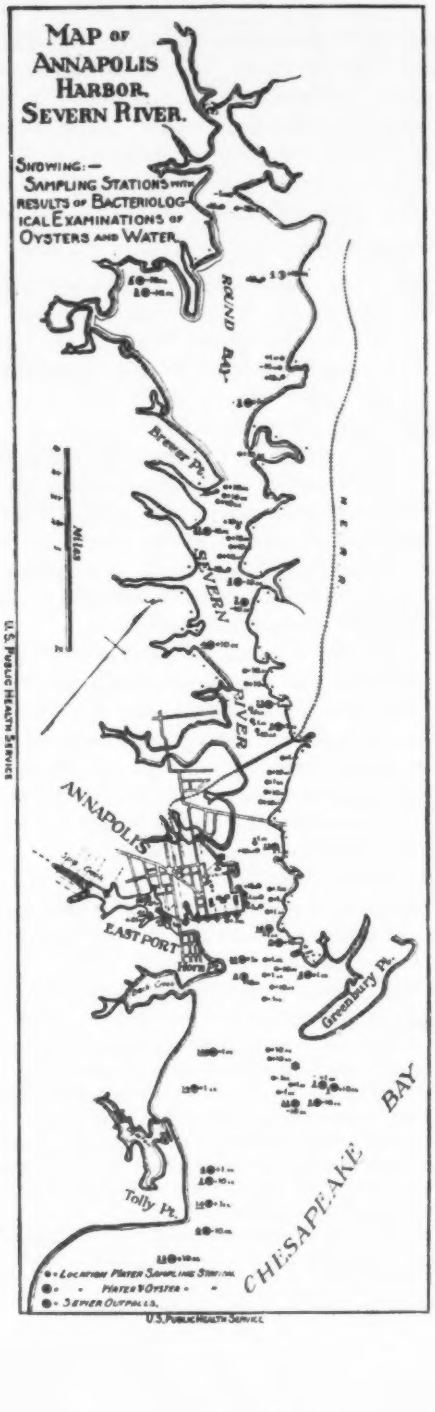
[1] See map of area No. 8.

MAP NO. 8.


MAP OF ANNAPOLIS HARBOR, SEVERN RIVER.
SHOWING:— SAMPLING STATIONS WITH RESULTS OF BACTERIOLOGICAL EXAMINATIONS OF OYSTERS AND WATER.
ROUND BAY
Brewer Pt.
SEVERN
RIVER
Miles
ANNAPOLIS
EASTPORT
Greenbury Pt.
Tolly Pt.
CHESAPEAKE BAY
● = Location Water Sampling Station
● = " Water & Oyster " "
● = Sewer Outfalls.

U.S. PUBLIC HEALTH SERVICE

U.S. PUBLIC HEALTH SERVICE

An auxiliary supply is derived from five artesian wells. It is stated that during summer months, when the city water supply is low and has a bad taste and odor due to algae, the supply is treated with chlorine gas before delivery. The Naval Academy derives its water supply from artesian wells.

There are 280 privies in the city. The remainder of the houses, St. John's College, and the Naval Reservation are connected with a number of public sewers, the outlets of which are indicated on the accompanying map. There are also about 75 private sewers.

Bacteriological samples.—As the tables show, 35 samples for bacteriological and chemical anlysis and 18 miscellaneous or oyster-bed samples for bacteriological examination, collected by the Bureau of Chemistry on four trips, were examined at the Hygienic Laboratory, Public Health Service, and 15 samples of oysters and 27 samples of water, collected by the steamer *Bratton* and examined at once on board, showed *B. coli* present in the water in quantities varying from 0.1 c. c. opposite and below the town, to 1 c. c. up and into Round Bay, and present in samples varying from 1 c. c. to 10 c. c. down to a line between Greenbury Point, on the northern bank, and the mouth of Lake Ogleton, on the southern bank of the river. These samples were taken at various seasons of the year. The chemical results obtained by the Bureau of Chemistry from samples taken off Santee Wharf at the academy "showed free ammonia of 0.02 to 0.04 mgs. per liter and nitrites of 0.001 to 0.007 mgs. per liter. These amounts increased on passing down the stream, the free ammonia ranging from 0.01 to 0.14 mgs. per liter and the nitrites ranging from 0.001 to 0.007 mgs. per liter." The other chemical and bacteriological results show corresponding changes.

Fifty-five samples of water, collected by the Bureau of Chemistry and by the Public Health Service steamer *Bratton*, showed an oxygen content ranging from 80 per cent (outside Greenbury Point Light, near buoy) and 82.91 per cent of saturation (at Buoy 5 on the channel, just inside Greenbury Point) on June 26, 1914, to maxima of 96.10 and 97.52 at the same points on February 2, 1914. These are ebb tide conditions. Samples taken on a flood tide from triangle 50, Brewer Point, off the mouth of the creek, varied from 62.36 per cent saturation, June 25, 1914, to 100 per cent, March 12, 1914.

Pollution from sewage.—The tidal current in the bay channel off Sandy Point is only 0.63 mile per hour, the tidal current within Annapolis Harbor is still less, and the stream flow into the river is almost negligible, owing to the small watershed, consequently the harbor and river water is by no means renewed every tide, though a large quantity of water does enter on each flood tide. Sewage discharged during flood tides is carried up the river and along the fore shores and creeks. The discharge during the last two hours or so of ebb tide is probably diluted and brought back by the flood tide. Here, as elsewhere in true tidal waters with high saline content, there is a marked sedimentation and subsidence during slack water. Evidence of gross pollution and deficient oxidation is apparent near the slips about the market place.

There are extensive and valuable oyster beds in Round Bay, at the head of the Severn River, and along the shoals of the river and creeks all the way down to and in Chesapeake Bay. At the time of inspection, September, 1914, there were several thousands of bushels of oysters being kept in Spa Creek, above the bridge and within 200 yards of the outlet of the sewer from a general hospital. Samples of water from Spa Creek gave *B. coli* present in 0.01 c. c. in 66 per cent, and in 0.1 c. c., but not in 0.01 c. c. in 33 per cent, while oysters from the same area gave scores of 41 and 23.

Typhoid fever reported in Annapolis, Anne Arundel County, Md.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
								1	......	3	1	......	[1] 5
1908	......	......	2	1	......	2	2	11	2	4	3	2	29
							1	......	1	......	......	......	[1] 2
1909	......	......	......	1	......	......	1	......	3	3	2	2	12
			1	......	......	1	1	7	4	......	3	5	[1] 22
1910	1	......	......	......	......	......	2	5	4	......	1	1	14
		1	......	......	......	1	3	2	......	1	......	......	[1] 8
1911	1	......	......	......	......	1	......	5	1	......	......	1	9
								1	......	......	......	......	[1] 1
1912	......	......	......	1	......	1	2	1	2	2	2	1	12
1913	1	......	......	......	......	1	3	2	3	2	......	......	12
								1	......	1	......	......	[1] 2
1914	......	1	2	......	2	1	3	......	1	1	1	......	12
1915	......	1	......	......	......	......	......	......	......	......	......	......	1
Total	3	3	5	3	2	8	18	36	21	17	13	12	141

[1] Cases in Eastport, a suburb of Annapolis.

Cases in Annapolis	141
Cases in county	573
Population of Annapolis	9,209
Population of county	39,553

The many sewers along the shore, from which fresh raw sewage is discharged, and the immediate or close proximity of oyster beds, eliminate the time factor as an element of safety. The factor of dilution, however great it may appear upon superficial observation, was proven, by repeated bacteriological and chemical examinations of water and shellfish at various seasons, to be insufficient for the disposal of this volume of sewage. So long as present conditions are allowed to exist, the taking of shellfish for consumption from the waters between a line drawn from Greenbury Point to the mouth of Lake Ogleton, up to the upper railroad bridge, should be prohibited.

The conditions are well known to the local authorities and to the State board of health, who have recommended a project in outline for a sewage-disposal system which would eliminate the danger of infectious pollution of oysters. Any system, to be adequate, must include the disposal of sewage from the United States Naval Academy; but so far efforts to secure cooperation have failed. The health and welfare of the 1,000 or more officers and midshipmen who are maintained by the United States at the Academy are necessarily affected by the sanitary conditions which surround them. It is believed that the National Government will not fail to provide for this important matter, if proper representations are made. Similar conditions existed at Hampton Roads, where the National Home for Disabled Volunteer Soldiers discharged raw sewage onto oyster beds. Proper representations in that case have resulted in the remedying of conditions. The conditions existing in Spa Creek indicate great danger of infection from oysters kept therein, and the taking of oysters therefrom should be forbidden.

An exhaustive study of Annapolis Harbor is now being conducted by the Public Health Service in cooperation with the State department of health.

SOUTH RIVER.

South River empties into the west side of Chesapeake Bay 125 miles above its mouth and about 3 miles below Severn River entrance. Thomas Point Shoal lighthouse marks the northern point at the entrance. This river has a rather narrow channel and is navigable for about 8 miles above the entrance; it is crossed by a drawbridge about 4½ miles above its mouth. The post village of Edgewater, with a population of 24, is on the north bank at the bridge; and the post village of Riverview, with a population of 47, is on the south bank about 1 mile above the bridge. The river drains a sparcely inhabited area and no direct pollution of consequence is discharged into it.

Three trips were made for the collection of samples. Upon the first trip 15 samples of water and 10 samples of oysters were collected (February 3, 1914) by the *Fish Hawk* and forwarded to the Hygienic Laboratory for examination. All but two samples of water showed *B. coli* absent in 10 c. c. One of the two samples showed *B. coli* present in 10 c. c. but not in 1 c. c.; the other sample, which was taken off Marshy Point at the mouth of the river, gave *B. coli* present in 1 c. c. The oyster samples showed high colon scores, one sample from bed 55 giving a score of 410. Subsequently, collections were made by the *Bratton*, June 25 and September 14, 1914. All of these samples were immediately examined on the *Bratton;* the oysters gave low scores and the water samples showed a low bacterial content, except one taken from near the mouth of a slough at Selby Creek which drained some cultivated land. The samples taken by the Bureau of Chemistry on the *Fish Hawk* February 3, 1914, were delayed en route to the Hygienic Laboratory and the results obtained from them should be disregarded in light of the sanitary survey and subsequent laboratory results. There are extensive oyster-bearing areas in the river and the sanitary conditions are believed to be safe.

The custom of keeping oysters on the foreshore near privies here and elsewhere in this section is dangerous and should be prevented.

The whole bay west of the channel between the mouth of the Severn and South Rivers is practically one great oyster area. Bay Ridge and "Arundel on the Bay" are summer resorts on the shore just below Tolly Point, and shellfish should not be taken from the immediate foreshore during the summer season. While there are deep wells at Arundel, the water contains much iron and shallow wells are used; moreover, privies are general. The beds are covered and washed by the waters of the Chesapeake Bay and are safe except as noted. During the oyster season the resorts are practically uninhabited.

WEST RIVER.

West River empties into the western side of Chesapeake Bay, 122 miles above Cape Henry and about 6 miles below the Severn River. The river is short, drains a small area, and 9 feet draft can be carried 3 miles from its mouth. Galloway is a post village with 160 inhabitants, 2½ miles above Curtis Point, on the west bank. Shady Side is a post village and summer resort on a cove above the point. The permanent population was 125 persons in 1910, but this number is considerably increased by summer residents.

RHODE RIVER.

Rhode River, emptying into the north side of West River just inside its entrance, has a depth of 9 feet for about 2 miles above its mouth. It drains a small area. The post village of Mayo and its landing are on the north bank above its mouth. They have a population of about 100.

Of the samples taken at various times in the West and Rhode Rivers, one taken 100 yards below the wharf at Galesville on Tent House Creek gave *B. coli* present in 1 c. c. quantities; the oysters gave a score of 3. It is probable that the source of pollution was local. The oysters from these localities are safe.

HERRING BAY.

Herring Bay is a broad bight in the western shore, about 12½ miles below Annapolis Harbor entrance and 25 miles above the Patuxent River entrance. The post village of Fairhaven, with a population of 35, is a steamboat landing opposite the opening into Chesapeake Bay. From it large quantities of oysters and produce are shipped by regular steamers to Baltimore. Deale is a post village of 52 persons on Rockhole Creek, at its entrance into the northern side of Herring Bay.

That part of Anne Arundel County included in the peninsula formed by West River on the North and Herring Bay, including the communities of Shady Side, Deale, and Churchton (population, 150) is rather thickly settled. For several years the typhoid fever rate has been very high in this district, and an intensive sanitary survey of the county was made by the Public Health Service and State department of health conjointly in 1915.

The following statistics furnished by the State department of health show the prevalence of typhoid fever. It is to be remembered, however, that the cases reported are not only from the populations given, which are based upon the census of 1910, but from all those who secure mail from these post offices, and this is true of all reports from Maryland.

Typhoid fever reported in Deale, Anne Arundel County, Md., 1908 to 1914, inclusive.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1908										1	3	1	5
1909											2		2
1910					1		2	1			1		5
1911							1	2	5				8
1912			1		1	1	4	3	3	6	5		24
1913							1			3			4
1914													
Total			1		2	1	8	6	8	10	11	1	48

Cases in Deale	43
Cases in county	573
Population of Deale	52
Population of county	39, 553

Shady Side, Ann Arundel County, Md.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1908			1		1								2
1909													
1910									1				1
1911							2						2
1912										1			1
1913													
1914													
Total			1		1		2		1	1			6

Cases in Shady Side	6
Cases in county	573
Population of Shady S	125
Population of county	39, 553

Churchton, Anne Arundel County, Md.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1908													
1909											1		1
1910			1										1
1911			1				1		2	2	1		7
1912									1		1		2
1913				1		1		3	4	1		2	12
1914	6	1								1	1		9
1915													
Total	6	1	2	1		1	1	3	7	4	4	2	32

Cases in Churchton	32
Cases in county	573
Population of Churchton	160
Population of county	39,553
Percentage of typhoid to population of county, 6 years	1½
Percentage of typhoid to population of Churchton, 6 years	20
Percentage of typhoid to population of Deale, 6 years	92
Percentage of typhoid to population of Shady Side, 4 years	4½

One of the largest shellfish areas in the bay extends from abreast the mouth of Annapolis Harbor down to Holland Point, the southern point at the entrance to Herring Bay. The oysters from these beds are free from pollution.

Chesapeake Beach is a summer resort on the west shore of the bay, 2½ miles south of Holland Point. There are a hotel, pier, and other buildings. During the summer months this resort is frequented by hundreds of people from Washington, with which city the resort is connected by rail. The nearest oyster bed is a mile or more offshore and would scarcely be affected by sewage from the resort which, moreover, is not frequented during the oyster season.

PATUXENT RIVER.

Geographical features.—The Patuxent River empties into the western side of Chesapeake Bay, 17 miles above Point Lookout. Its shores are bold and the channel wide and deep. It is navigable for vessels of 19 feet draft for 21 miles, and for 11 feet draft to Nottingham, 35 miles above its mouth; 9 feet draft can be taken for 41 miles, to the landing at Bristol. There are numerous landings within this stretch and there is a considerable trade in produce and oysters carried by coasting and sailing vessels and steamers.

Many creeks empty into the river, but only one is of sanitary importance. Mill Creek empties into the river from the north about 1½ miles above Drum Point at the mouth of the river. At the mouth of the creek, and diverting it eastward, is Solomons Island, on which there is a community of about 500 persons (census 1910, 318 persons).

The population of the island is 4,240. There are several marine railways and shipyards and a considerable trade in oysters, fish, crabs, and produce. There is also a large "fish factory" for the treatment of menhaden, to secure oil. There is no public sewerage system, but there are several private sewers which discharge along the shore. The water supply is derived from deep and shallow wells. The ordinary open surface privy is commonly used.

Only two cases of typhoid fever have been reported to the State department of health since 1908, one in August and one in November, 1909; but there have probably been others. The only other communities of consequence are Laurel, a town of 2,415 inhabitants, about 80 miles above the mouth of the river; Bristol, a village of 85, about 41 miles above it; Nottingham, a village of 109, 35 miles above it; Lower Marlborough, a village of 130, on the east bank, 29 miles above it; Benedict, a village of 150, on the west bank, 21 miles above it; and Broome Island, a community of 100, about 12 miles above it. Thirty-two cases of typhoid fever have been reported from Broome Island during the seven years ended 1914. During 1914 there were reported: August, 3; September, 6; October, 4; and November, 4. There has been only one case reported in winter months.

There are oyster beds on each side of the channel of the Patuxent River and in numerous creeks from the mouth of the river up to about Gods Grace Point, which is 18 miles above Drum Point. The current is so sluggish and the amount of sewage from Laurel so small that it is not probable that this pollution reaches the upper limits of the oyster beds 50 miles below in such quantity or condition as to be dangerous.

Collection of samples and results obtained.—Two trips were made by the *Fish Hawk* and one by the *Bratton* for the collection of samples of oysters and water in the Patuxent River. January 30, 1914, 15 samples of water and 7 of oysters were collected and shipped to the Hygienic Laboratory, where they were received after considerable delay. One sample of water collected at Point Judith and one at Triangle No. 22 off Solomons Island gave *B. coli* present in 1 c. c. Of the seven samples of oysters, one taken from bed No. 2, between Benedick and Mill Creeks, scored 41, with *B. coli* absent in 1 c. c. of water from over the bed; one from bed No. 3 at the mouth of Persimmon Creek scored 32, *B. coli* absent in 10 c. c. of water; one from bed No. 31, off Parkers Wharf, scored 1,400, with *B. coli* absent in 10 c. c. of water; and one taken from bed No. 14, off the mouth of Cuckhold Creek, scored 140, with *B. coli* absent in 10 c. c. The temperature of the water from which these samples were taken was 6° to 7°.

March 10: Ten samples of water were taken by the *Fish Hawk* in about the same localities, 4 of which showed *B. coli* present in 10 c. c., but none in 1 c. c.

September 11, 1914: Ten samples each of oysters and water from approximately the same localities were collected and promptly examined on the *Bratton*. Of these, the highest score obtained in oysters was 23, in a sample from the mouth of Town Creek; the greatest pollution obtained in water was *B. coli* present in 1 c. c., at the mouth of a creek below Broome Island. Chemical analyses made by the Bureau of Chemistry indicate a small increase in free ammonia (0.17 to 0.46 parts per million), and nitrites (0.0 to 0.004 parts per million).

If a decision as to the sanitary condition of the oysters taken from the Patuxent River were to be made from the samples taken January 30 it would be very unfavorable. The samples were delayed three days en route; whereas other samples, promptly examined, showed a very fair condition. It is possible that heavy rains may have washed down a considerable amount of pollution from agricultural sources, as well as from the small communities. Neither of the oyster samples which scored high were taken from near any apparent sources of human pollution. The oysters from the Patuxent River as a whole may be considered safe. No oysters should be taken from the waters immediately around Solomons; however, no oysters were found in close proximity to this town.

POTOMAC RIVER.

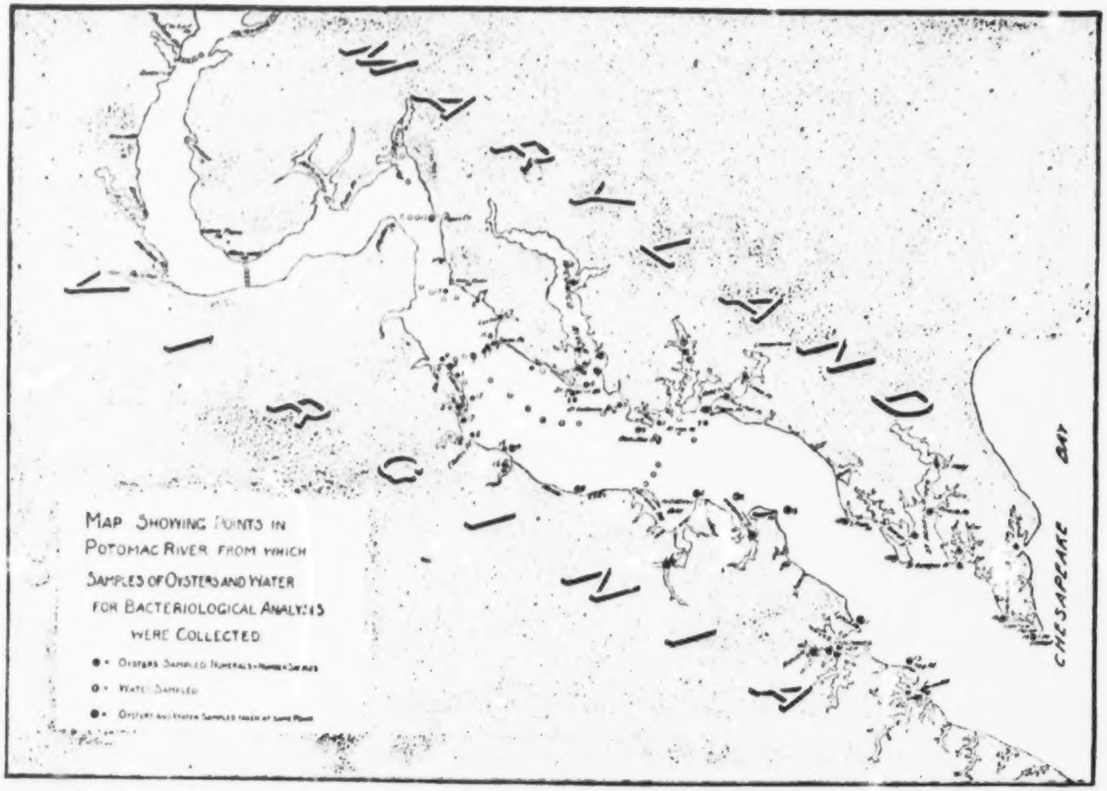
This important tributary of Chesapeake Bay enters its western side about 60 miles above Old Point Comfort and forms the boundary between the States of Maryland and Virginia. It is the approach to the cities of Alexandria, Va., and Washington, D. C. The Potomac is navigable as far as Georgetown, about 102 miles above its mouth. The entrance of the river between Point Lookout on the north and Smith Point on the south is about 10 miles wide, but south of Point Lookout it is but 5½ miles.

The Potomac drains an area of about 14,000 square miles, on which lives a total population of about 700,000.

The bed of the river itself and those of its many tributaries, from about Lower Cedar Point to the mouth of the river, constitute one of the most important and extensive oyster-bearing areas in the United States. The shellfish areas in the main river are under the joint control of the States of Maryland and Virginia.

The chief sources of pollution are the above-mentioned cities. An exhaustive study of the effect of this pollution has been made by the Public Health Service. This study, which extended over a period of 12 months, from about June 1, 1913, to June 1, 1914, included a study of the sanitary conditions of the oyster beds in the lower river and its tributaries. A full report upon the investigation is published as Hygienic Laboratory Bulletin 104.

MAP NO. 8.



MAP SHOWING POINTS IN POTOMAC RIVER FROM WHICH SAMPLES OF OYSTERS AND WATER FOR BACTERIOLOGICAL ANALYSIS WERE COLLECTED

MARYLAND
VIRGINIA
CHESAPEAKE BAY
● Oysters Sampled [illegible]
○ Water Sampled
● Oysters and Water Samples taken at same Point

[illegible]—Bull. 74—[illegible] (To face page 74.)

74a

The study of about 10,000 samples of water and 461 samples of oysters showed that no dangerous pollution from the cities reaches the beds in the river and that the oysters in the tributaries were, with a few exceptions, also free from danger. The exceptions were a small bed in Monroe Bay near the outfall from the sewage disposal system of Colonial Beach, Va.; oyster beds in proximity to a drain at Rock Point on the Wicomico River, Md.; and oyster beds near a fish wharf and drain at Lewisetta, Va. These places are small in extent, few oysters are taken from them, and they constitute an inconsiderable proportion of the great quantities of oysters gathered from the Potomac River. The taking of oysters from the above small areas should be prohibited. With these exceptions Potomac River oysters are safe when taken from their beds.

GREAT WICOMICO RIVER.

The Great Wicomico River empties into Chesapeake Bay about 5 miles below Smith Point; it flows in a southeasterly direction and is navigable for a distance of about 7 miles above Fleet Point, where Cockrell Creek empties into the river. Located on the banks of Cockrell Creek are four fish-oil factories and three small towns, Reedville, Freeport, and Fleeton, with a combined population of from 1,200 to 1,500. The towns have no sewerage systems and only a few private sewers empty directly into the creeks. The fish-oil factories contribute practically all the contamination in this stream, but as this pollution is noninfectious it has only an æsthetic relation to the condition of the stream.

The Great Wicomico River runs through sparsely settled country and receives no great amount of pollution, except such as might be expected from an agricultural country. Oyster beds are found on practically all the bars and flats, and even in the channel, from the mouth of the river to the head of navigation. Samples of oysters collected all along the river show no sign of serious pollution, even in the hot summer months, at which time the samples were collected. Of the series collected one sample alone showed traces of pollution, and that was directly traceable to washings from cultivated land, as the sample was taken from the mouth of a small creek that drains farming land. The river water showed traces of pollution, which was doubtless due to agricultural washings from the surrounding country.

RAPPAHANNOCK RIVER.

The Rappahannock River rises on the eastern slopes of the Blue Ridge in Rappahannock and Fauquier Counties, Va., and takes a general southerly course to Chesapeake Bay, into which it discharges about 36 miles from Cape Charles and 25 miles south of the Potomac River entrance. It is about 132 miles long and its drainage area is approximately 2,700 square miles. There is a considerable fall at the city of Fredericksburg, about 90 miles above its mouth; below that point it is a sluggish tidal navigable stream, spreading out in places to a width of several miles.

The river is of considerable commercial importance, steamers from Baltimore and Norfolk making regular trips to Fredericksburg and the various communities and landings below that city. The principal trade comprises cargoes of oysters, fish, farm produce, and general merchandise.

The principal tributary above tidal water is the Rapidan, which drains a sparsely settled area of 745 square miles and enters the river 10 or 12 miles above Fredericksburg. There are no tributaries of commercial importance except Corrotoman River, Urbanna, and Carter Creeks.

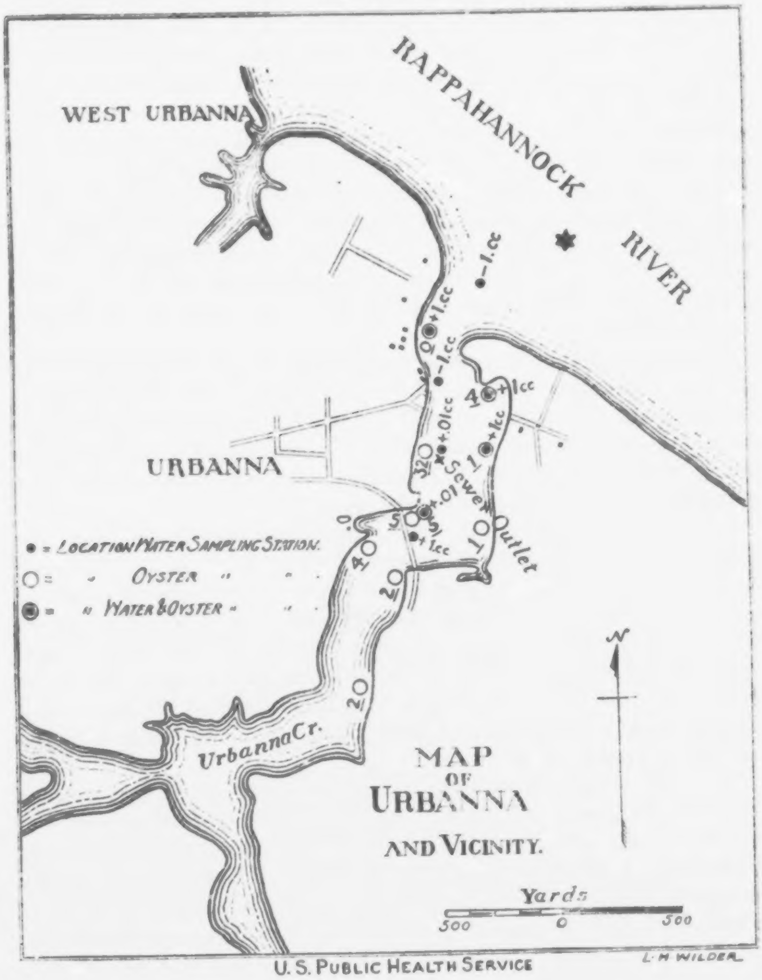
Fredericksburg.—The city of Fredericksburg is situated on the right bank of the Rappahannock, 90 miles above its mouth. The population of 5,874 derives its public water supply from springs and from the Rappahannock River. Analyses of water from the springs showed excellent quality. The river water is stored in sedimentation tanks before distribution. A considerable proportion of the houses are connected with public sewers which discharge their contents, untreated, into the river.

Other points on river.—Port Royal, a town of 194 persons, and Port Conway, a village of 80, are on opposite sides of the river, 64 miles above its mouth. No direct pollution of consequence enters the river from these communities. Tappahannock is a village of 478 inhabitants, on the west bank of the river, 38 miles above its mouth. There is no public sewerage system. The physicians of the town state that there has been very little typhoid fever since the use of artesian wells has become general, but that there is considerable typhoid in the rural districts away from the river.

Results of investigation.—The oyster beds of the Rappahannock River begin about Bowler's Rock, 10 miles below Tappahannock and 60 miles below Fredericksburg, and extend to the mouth of the river, which, even as far up as Bowler's Rock, is about 1½ miles wide and quite deep. Bacteriological examinations of oysters and water collected by the steamer *Bratton* in March, 1914, showed *B. coli* absent in 1 c. c. in every sample of water, and no oyster scored above 5. There were 12 samples each of water and oysters collected in the river. The weather and stream flow were such that it was expected *B. coli* would be present in 1 c. c. quantities. June 10 another series of samples was taken, when *B. coli* were present in 10 c. c. amounts in 6, and in 1 c. c. in 1, out of 11 samples. No oysters scored over 14. The stream flow at that time was small, but the land had been cultivated.

Judging from results of the Potomac investigation, it is quite improbable that infectious pollution reaches the beds from Fredericksburg, the only source of considerable pollution of the Rappahannock, and the results are probably due to agricultural wash. The oysters from this river are safe.

MAP No. 10.


RAPPAHANNOCK RIVER
WEST URBANNA
URBANNA
Urbanna Cr.
Sewer Outlet
● = LOCATION WATER SAMPLING STATION.
○ = " OYSTER " "
◉ = " WATER & OYSTER " "
–1.cc
+1.cc
+.01cc
MAP OF URBANNA AND VICINITY.
N
Yards
500 0 500

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L. H. WILDER

Tributaries.—Urbanna Creek is a small estuary which discharges into the Rappahannock from the south about 15 miles above Stingray Point Light at the mouth of the river. The creek is an excellent harbor and on its west bank is the town of Urbanna, with a winter population of about 475. There are several oyster and tomato packing houses, and during the summer the population is increased to 800 or more by the influx of laborers employed in the canneries. The town is situated on a high, well-drained bluff. Its water supply is obtained from artesian wells 500 to 700 feet deep, and a large proportion of the inhabitants use water from these sources. About 18 houses are connected with a sewer, the outlet of which is in the creek just off the center of the town. Samples of water taken near this outlet gave evidence of pollution potentially dangerous. One instance was noted where an oyster dealer, who supplied local trade, kept his oysters in a pile on a bed at the end of a dock not far from the sewer outlet and within a few feet of three privies which overhang the water and are used by the occupants of boarding houses for negroes. While there are a few small beds in the creek, practically all of the oysters shipped from Urbanna are from perfectly safe beds in the Rappahannock River.

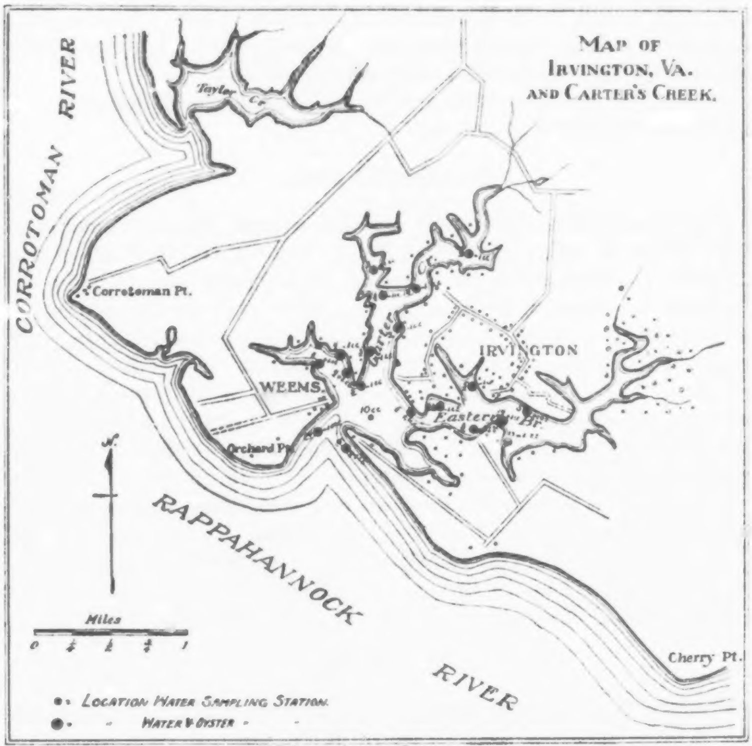
Corotoman River enters into Rappahannock River from the north about 10 miles above Stingray Point Lighthouse. The river is buoyed and navigable for vessels of 15 feet draft for at least 3½ miles above its mouth, but the only community of consequence is Millenbeck, a village and landing with 132 persons, just inside its mouth. No pollution of consequence enters the river.

Carters Creek discharges into Rappahannock River from the north about 10 miles above Stingray Point Lighthouse. The creek has a narrow, crooked channel which has been dredged and improved by a cut 15 feet deep through the bar and 12 feet into the eastern branch of the creek. There is good anchorage and the creek is used as a harbor of refuge. There are two communities on the creek; on the west bank, just inside the entrance, is the village of Weems, with a population of 240 persons. A large oyster shucking house is at the landing. Artesian water is used.

The creek divides into three prongs or branches, a short western one, Church Prong, on which there is a large fish factory, and the eastern prong, on which is the town of Irvington, one of the most important oyster shipping points in Virginia. There are a number of oyster shipping and shucking houses, and it is stated that between 300,000 and 400,000 bushels of oysters are shipped annually either in the shell or shucked. Irvington, with a population of 1,035 persons, is situated on rather high, well-drained land. The water supply is mostly derived from artesian wells and is of excellent quality, though some shallow wells are used. There is no public sewerage system and privies are used. In a few instances privies may be seen overhanging the banks. The town has been remarkably free from typhoid fever since the installation of artesian water supplies.

Practically all of the bottoms in the creek and the shoals outside are occupied by leased oyster beds. It was stated that few oysters are ordinarily shipped from beds within the creek, such oysters being chiefly used for local trade. These beds, however, are used for storing oysters caught in the Rappahannock, when demand is small and prices are low, and such oysters are afterwards shipped. A series of samples of oysters and water were collected from various beds along the branches of the creek, and of 19 samples of water 8, or 41 per cent, showed *B. coli* present in 1 c. c., of which 2 showed *B. coli* present in 0.1 c. c. The total count, on agar at 37°, ranged from 60, in a sample taken at the head of Church Prong, to 1,980. Of 19 samples of oysters only 2 scored as high as 23, these having been taken in the eastern branch comparatively near Irvington Wharf. The total counts were all high. The high *B. coli* content of the water suggests an unsatisfactory local condition.

MAP No. 11.


MAP OF
IRVINGTON, VA.
AND CARTER'S CREEK.
CORROTOMAN RIVER
Taylor Cr.
Corrotoman Pt.
Carters Cr.
IRVINGTON
WEEMS.
10cc
Eastern Br.
Orchard Pt.
N.
RAPPAHANNOCK RIVER
Miles
0 ¼ ½ ¾ 1
Cherry Pt.
● Location Water Sampling Station.
● - Water & Oyster -

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The surface privies are certainly safer than would be a sewer discharging fresh sewage directly over the beds; but any privy overhanging or discharging near water in which shellfish are grown constitutes a potential danger, one which may not warn before it strikes. The amount of discharge from such sources is often too small to affect bacterial results, and the use of the privy may be continued with apparent impunity for considerable periods; sooner or later, however, typhoid excreta will be discharged with serious results.

The remedy for Irvington, Urbanna, and similar towns is cheaply and easily found in the installation of sanitary privies. These towns depend to a large extent upon the oyster industry and the oyster planters themselves should initiate such measures.

As a whole the oysters shipped from Rappahannock River points are free from pollution and safe.

PIANKATANK RIVER.

Piankatank River discharges into the western side of Chesapeake Bay, about 32 miles above Old Point Comfort and just below the entrance to Rappahannock River; it is navigable for 14 miles to Freeport, a village of 48 inhabitants. Hills Bay in the south side of the entrance, inside of Gwynn Island, is a bight which forms the approach to Milford Haven (160) and Queens Creek (130). There are about 1,000 inhabitants on Gwynn Island. No direct pollution of consequence enters the Piankatank, and shellfish from this area and from the natural beds in Chesapeake Bay outside of Gwynn Island are free from infectious pollution.

Horn Harbor, which gives its name to a well-known type of oysters, is a shallow estuary which runs about 3 miles into the land a short distance above New Point Comfort Light. Winter Harbor is a similar but smaller estuary just north of Horn Harbor and south of Gwynn Island. Oysters from both areas are free from pollution.

MOBJACK BAY.

Mobjack Bay, another well-known oyster area, is a large irregular bay making into the western shore of Chesapeake Bay, about 17 miles north of Old Point Comfort and just northward of York River entrance, the entrance between New Point Comfort to the north and Plum Tree Point to the south virtually forming one entrance for both York River and Mobjack Bay. The distance between the two points is about 12 miles. The bay has four tributary rivers or estuaries, upon all of which are numerous landings and handsome country estates; but there are no towns or villages of importance upon either the bay or its tributaries. A large part of the bay and its tributaries is occupied by public and leased oyster beds, and there is an extensive trade by regular lines of steamers and by coasting vessels between Norfolk, Fort Monroe, and this section.

East River.—East River empties into Mobjack Bay 4¾ miles northwestward of New Point Comfort. It has a channel with a minimum depth of 14 feet for 3½ miles above its mouth.

Diggs Wharf, with a population of 60, is on the east bank and Philpotts Wharf, with a population of 132, on the west bank just inside the mouth of the river. Williams Wharf and Hicks Wharf are opposite each other 3 miles above the mouth. Pulling Creek is a small tributary which empties into East River, about 3¼ miles above its mouth, and extends about 3 miles northeastward to head near Mathews County, Va., courthouse. Mathews has a population of 356 and no public sewerage system.

Of the eight samples each of oysters and water taken from the uppermost beds of East River and Pulling Creek, all but one showed *B. coli* present in 1 c. c. of water. The river drains a very sparsely settled small area. No sewerage systems discharge into it. The few houses along its banks have privies, none of which are immediately on the shore; moreover, the volume of water is very large. There had been a very heavy rain two days before, and a gentle rain the day before, the samples were taken, at which time it was very cold and snowing. The temperature of the water was about 4° and to this latter fact may be due the absence of higher score in oysters, none of the samples having scored over 23. It is most probable that the *B. coli* content was due to the washings from the farms along the banks. Taking into consideration the sanitary survey, it is believed that oysters from this river are free from pollution from human sources and are safe.

North River.—North River, discharging into the northern part of Mojack Bay just west of East River, is over 1¼ miles wide at its mouth, with shoals on either side which leave a channel five-eighths mile wide at the entrance but gradually narrowing.

Auburn Wharf, on the east bank about 4 miles, and Dixondale Wharf, on the west bank, about 5 miles above the mouth of the river, are the two landings. There are no communities, both sides of the river being occupied by large country estates. No sewer was found and a gentleman stated that the owners of the estates had agreed among themselves to use cesspools, so as to avoid pollution of the river. The one sample which gave *B. coli* present in 1 c. c. came from a point where no sources of human pollution were present. The oysters from this area are believed to be quite safe.

Ware River.—Ware River, discharging into the western side of the head of the Bay, is navigable for 5 miles above its mouth. A steamer makes regular trips between Norfolk and the three landings, Roanes and Smith Wharf on the west bank and Hockley Wharf on the east bank. A scattered community of 55 persons is located back of Roanes. The oysters from this area are believed to be safe.

Severn River.—Severn River discharges into the western side of Mobjack Bay about 6 miles westward from New Point Comfort. This river is formed by the union of Northwest Branch and Southwest Branch and is navigable for 4 or 5 miles. There is one wharf on each branch. The shores are sparsely settled and oysters from the area are believed to be safe.

All four of the above tributaries to Mobjack Bay are merely large, deep, tidal estuaries. The wide common entrance of Mobjack Bay and York River, its position nearly opposite the entrance to Chesapeake Bay from the ocean, and small drainage area, make the saline content of the waters rather high. Most of the oysters from this area are shipped as barrel stock to be eaten raw and are free from the danger of infectious pollution.

YORK RIVER.

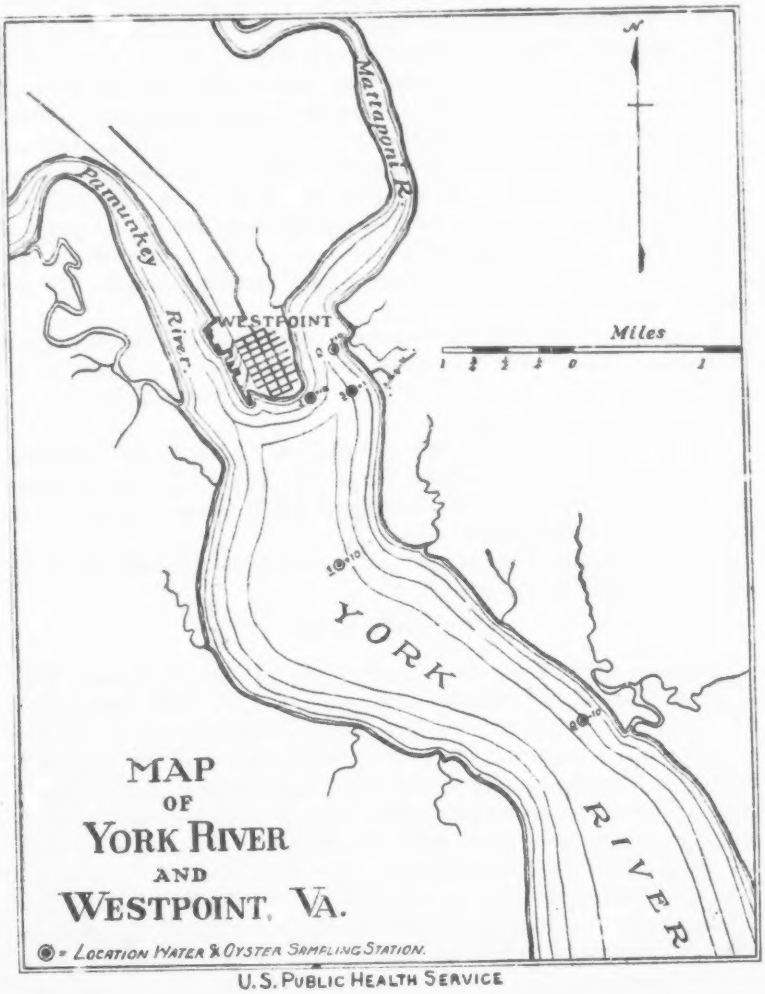
The York River, formed by the junction of the Pamunkey and the Mattaponi Rivers, flows in a southeasterly direction for about 30 miles and empties into Chesapeake Bay on the western shore, between Poquoson River and Mobjack Bay, the entrance being about 15 miles north of Old Point Comfort.

The numerous small creeks emptying into York River between its mouth and West Point are comparatively shallow and frequented only by small vessels carrying oysters or garden produce. Oyster beds cover all the shoals and bars on the north side of the channel and some beds are found on the south side. Oysters are shipped, both shucked and in the shell, from most of the numerous landings along the river.

There are no towns on the banks of the York River other than a few scattered houses at each of the steamboat landings between Yorktown at its mouth and West Point at its head.

West Point.—West Point, at the junction of the Pamunkey and the Mattaponi Rivers, is the terminus of a branch of the Southern Railroad and has some foreign and coastwise trade in cotton and tobacco. It is situated on a low lying headland, between the Pamunkey River on the south and the Mattaponi River on the north, where these two rivers join to form the headwaters of the York River. The town has a population of about 1,500 people, who are nearly all users of the public artesian water supply. A sewerage system connects with 30 to 40 per cent of the houses in the town and has three outlets, one of which empties into the Pamunkey River on the south side, another into the Mattaponi on the north side, and the third into the headwaters of the York River. The section of the city occupied chiefly by negroes is not sewered and ordinary privies appear to be common. A large pulp mill is situated on the Pamunkey River on the outskirts of the city. The mill uses an alkali method and the chief solid constituent of the effluent is said to be carbonate of lime. The immediate dilution is so enormous that the effluent has little effect upon the river water. The sanitary condition should be improved by a sewerage system and the abolition of surface privies. The water supply is good, which no doubt contributes largely to the comparative freedom of the city from typhoid fever. The health officer stated that every year there were cases of continued fever, but that

MAP No. 12.


N
Mattapony R.
Pamunkey River.
WESTPOINT
Miles
1 ¾ ½ ¼ 0 1
YORK RIVER
MAP OF YORK RIVER AND WESTPOINT, VA.
● = Location Water & Oyster Sampling Station.

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repeated examinations by the State board of health of specimens of blood had shown the disease not to be typhoid fever.

York River below West Point.—The only oyster area near the city is a small bar below the city between the two rivers; few if any oysters are taken therefrom and the area should be permanently abandoned because of proximity to a sewer outlet. There are also storage beds in the Mattaponi across the channel one-half mile from the city. These are safe. The oyster bearing area begins about 2 miles below the city. The York River is wide, deep, and straight, and its entrance is opposite the entrance of Chesapeake Bay, consequently the volume of sea water that enters at each flood tide is enormous. The Pamunkey and Mattaponi Rivers drain sparsely, almost uninhabited, watersheds, and the lateral drainage area of the York is very narrow. Notwithstanding the heavy rain during the night before the samples were taken, the results showed *B. coli* absent in 1 c. c. samples, except in the one taken opposite a large oyster shucking house. Oyster samples scored low in every case.

Yorktown.—Yorktown is a historic community of about 136 inhabitants. The houses are away from the river and there is no public sewer there nor at Gloucester Point, a group of five or six houses on the opposite bank.

Queens Creek.—Queens Creek is a shallow, unimportant tributary which enters York River above Yorktown; one of the head streams of this branch receives some drainage from Williamsburg, a city of about 3,000 inhabitants.

Oysters from the York River are believed to be safe and free from infectious pollution.

POQUOSON RIVER.

Poquoson River is an estuary which makes into Chesapeake Bay south of York River entrance, and west of York Spit Lighthouse. About 14 feet draft can be carried into the main river. It has several small tributaries which drain well cultivated farming land, from which garden produce and wood are shipped; it also had a large oyster trade, carried in power boats to Fort Monroe and Norfolk. Owing to the "green gill," the oyster trade has been practically negligible for several seasons.

There is no community on the river or its tributaries, but a few houses are built along the shore and there is a small shipyard on Cheesemans Creek. There is also a mill for grinding crab scrap into fertilizer.

Of the six samples of water taken, all gave *B. coli* present in 1 c. c. amounts; of the seven samples of oysters one scored 32 and the others 5 or less. It is probable they would have scored higher had the water been less cold. These samples were taken soon after a heavy rain and it is probable the *B. coli* content came from agricultural wash. In some instances the small private beds are in dangerous proximity to privies.

BACK RIVER.

Back River, Va., makes into the western shore of Chesapeake Bay about 6 miles north of Old Point Comfort. It is really a shallow tidal estuary, with a narrow, crooked channel. At its head, about 2 miles from the entrance, the river is divided into the Northwest Branch, extending northwestward about 2½ miles, and the Southwest Branch extending southwestward about 3 miles and ending in a narrow tidal gut, which extends to the suburbs of the town of Hampton, Va.

The post village of Earnest (Amory Wharf), with a population of 75, is on the north bank of the river near the entrance of Northwest Branch, and the scattered village of Fox Hill (post office name Rip Raps) is on and near the east bank of Harris or Harrison Creek, a small branch running southward just east of the mouth of Southwest Branch. The shores on both sides of the river are fairly thickly settled. On the north shore of the Southwest Branch, near its mouth, is a large stock and dairy farm, above and adjoining which is another large dairy stock and experimental farm belonging to the Hampton Normal and Agricultural Institute for Negroes. A sewer was noticed coming from the main building.

Of 24 samples of oysters and water taken upon two different trips, November, 1913, and February, 1914, three samples of water gave *B. coli* present in 10 c. c., but not in 1 c. c., and one sample gave *B. coli* present in 1 c. c. One sample of oysters gave a score of 50 with the water over the beds showing *B. coli* absent in 10 c. c. and a total count on agar of only 9. The tide was at its flood when the oysters were taken, which would explain the good quality of water, and the oysters had probably received their pollution from the stock farms on a previous ebb tide.

Oysters from this river have been noted since early colonial times, but for several years past there has been, in common with the other rivers of Chesapeake Bay, serious loss by "green gill." The oyster beds in Back River, Harris Creek, and Poquoson consist of many small beds controlled by some abutting property owners under lease, and by some under riparian rights.

Whenever open surface privies, or private sewers, are in the drainage area nearby, a certain amount of potential danger exists in beds situated immediately near shore in shallow water. Bacteriological examinations, even if they be extended over long periods, will fail to show any heavy pollution. Furthermore, no illness could follow ingestion of oysters from the area until infectious pollution was deposited, followed possibly by rains. Infection may occur in this way, however, and only by epidemiological study and topographical observation can the origin of the outbreak be traced. It is in such localities as these that State health organizations and local officers should enforce a system of sanitary privies with proper disposal of dejecta.

JAMES RIVER, VA.[1]

Geographical description.—The basin of James River, the most important stream in Virginia, extends entirely across the southern part of the State from west to east. It is bounded on the north by the Potomac and York River basins and on the south by the basin of the Roanoke. Its entire area comprises approximately 9,700 square miles[2] with a population of approximately 600,000, exclusive of Newport News.

James River proper is formed by the junction of the Jackson and Cowpasture Rivers in the northern part of Botetourt County; these rivers rise in the Alleghany Mountains in Highland County near the West Virginia line and the headwaters of the South Branch of the Potomac. The river breaks through the Shenandoah Mountains near Clifton Forge, takes a southeasterly course, and near Balcony Falls flows through the Blue Ridge, in each instance with sharp falls over solid rock. At other points similar, though less pronounced, falls and rapids occur as the river flows through the foothills. The tidal portion of the river begins at Richmond, about 87 miles above the mouth of the river, following a series of rapids about 116 feet high. The range of altitude for the entire basin is from sea level to 4,000 feet on the crest of the Alleghany Mountains. The monthly discharge in second-feet varies from a maximum of 71,300 (June, 1907) to a minimum of 1,330 (Sept., 1907) with a mean of 9,640 in 1907 to 7,550 in 1909 (*Ibid.*, p. 37). These observations were taken at Cartersville above Richmond.

The tidal waters of the James River extend for a distance of 87 miles from Richmond to Newport News, where the river discharges into the western part of Hampton Roads, about 20 miles west of the entrance to Chesapeake Bay.

There are many tributary streams below Richmond; the only ones of importance, however, are the Appomattox, Chickahominy, and Warwick Rivers, and Pagan Creek. The course of the river, from Richmond to City Point, is extremely tortuous and the current ordinarily sluggish, as are also the currents of the Appomattox from Petersburg to City Point, and the Chickahominy River.

The mean excess in duration of ebb over flood tide at Falling Creek, 2¼ miles below Richmond, is 1 hour 53 minutes; at City Point, 27 miles below, 1 hour 13 minutes; at Hog Island, 65 miles below Richmond, 25 minutes; at Warwick River, in the oyster area, 7

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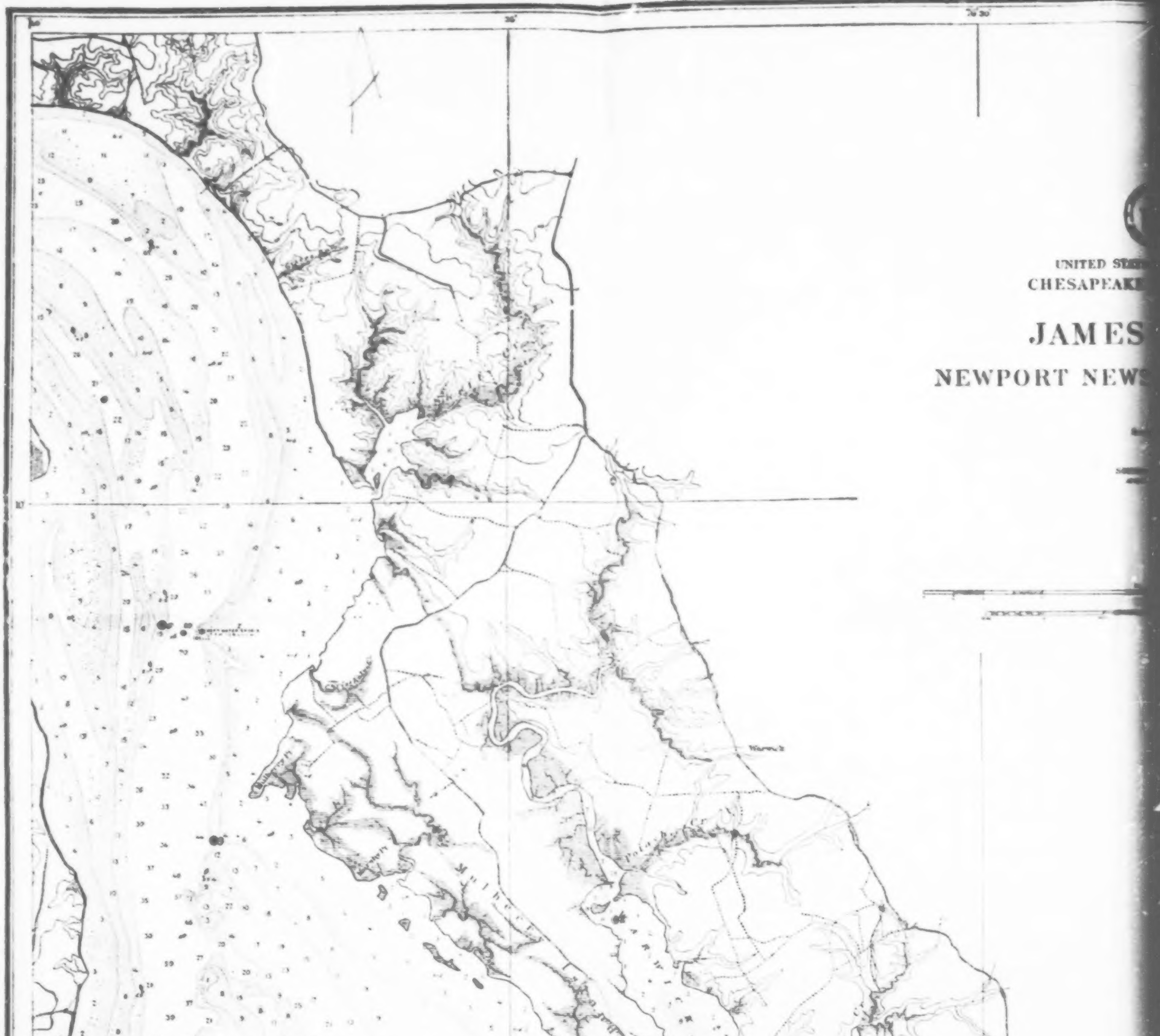
[1] See maps 1 and 13.

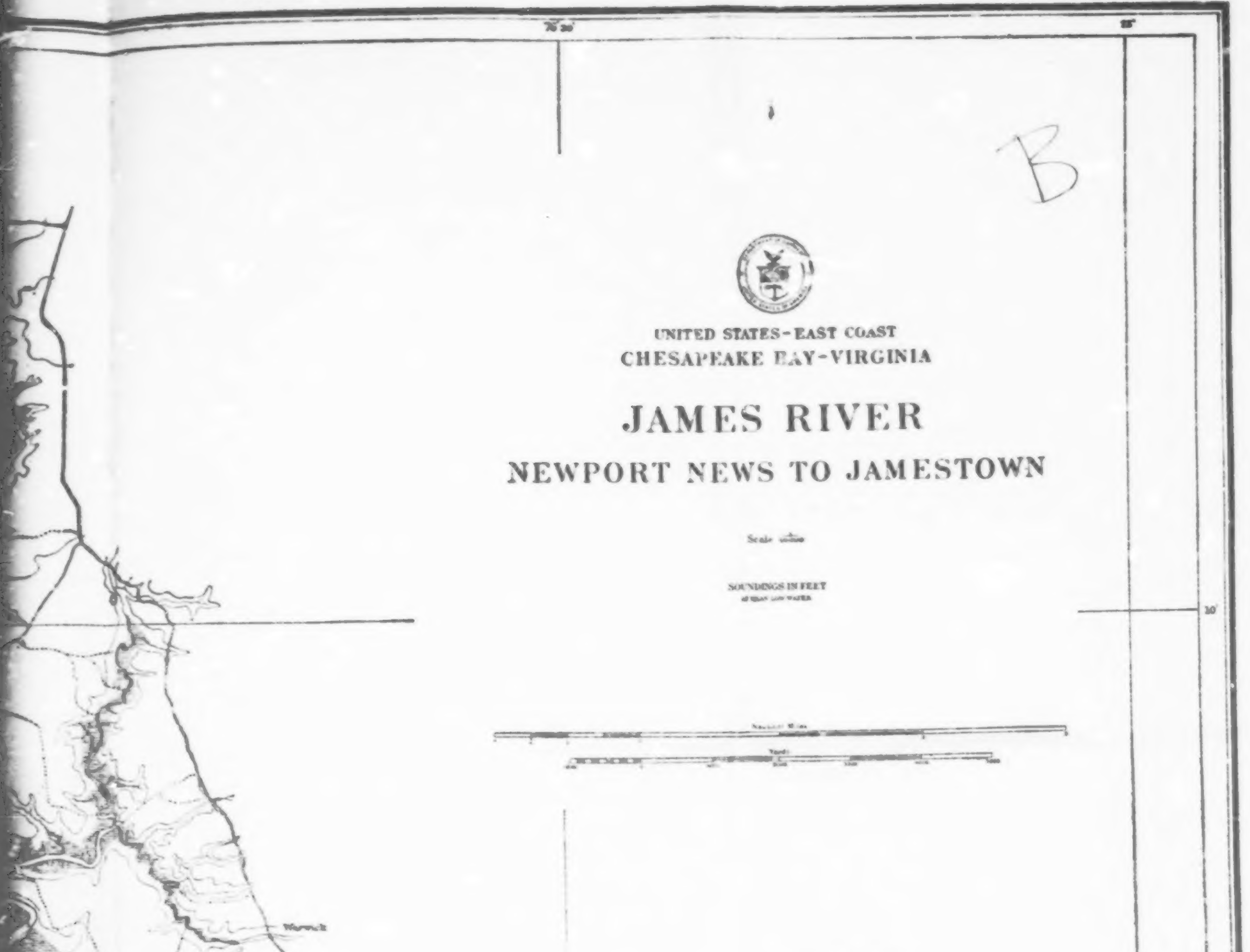
[2] Water-Supply Paper 262, U. S. Geological Survey, p. 29.

MAP No. 13


UNITED ST
CHESAPEAK
JAMES
NEWPORT NEWS
POINT OF SHOALS
Jail Pt
Jail I

MAP No. 13

B


76°30'
25'
30'
05'
UNITED STATES–EAST COAST
CHESAPEAKE BAY–VIRGINIA
JAMES RIVER
NEWPORT NEWS TO JAMESTOWN
SOUNDINGS IN FEET
Nautical Miles
Yards
TIDES
Newport News
Hog Point
ABBREVIATIONS
AUTHORITIES
Warwick
Curtis Pt
Jail Pt
Deep Cr

minutes. The mean rise varies from 3.7 feet at Richmond to 2.5 feet at Warwick River.[1]

The range of height of freshets at Richmond is from 5½ feet to 28½ feet, but the latter is exceptional. A freshet of 25.1 feet at Richmond was 14.5 feet at Dutch Gap, 2.2 feet at City Point, and hardly felt at Brandon, about 40 miles below.[1] This is due to the changing nature of the river which at Richmond, and a short distance below, is confined by high banks on both sides. Dutch Gap is a cut about 230 yards long, 100 yards wide, and 18 feet deep, 12 miles below Richmond. This canal was dug during the Civil War and cuts off a 4¾-mile bend; the water enters at a right angle to the course of the river and again takes a reverse right angle in leaving it. While there is a dam effect here, the left bank above is low and flooding relieves the normal bed. From City Point down, the river is from three-fourths of a mile to several miles wide, and, with the exception of the one-fourth-mile narrows at Weyanoke Point and one-half-mile narrows at Sturgeon Point, is a drowned valley, the slackening of the current in the wide areas causing sedimentation. The scouring effect in the upper river is much increased by numerous jetties constructed by the United States Corps of Engineers to deepen the channel.

At Mulberry Point, about the upper limit of oyster growth, the river is about 1¾ miles wide; immediately below, it widens and continues from 3 to 5 miles wide until it empties into Hampton Roads between Newport News Point on the east and Pig Point on the west.

Sources of pollution of James River.—No examination of the river above Richmond was made during this investigation. The chief sources of infectious pollution, however, are Lynchburg, a city of about 30,000 population, about 125 miles above Richmond; Charlottesville, near the Rivanna River, which empties into the James River at Columbia, about 60 miles above Richmond; and numerous small stations and communities whose sewage indirectly finds its way into the river.

The Monthly Bulletin of the health department of Richmond contains the following results of bacteriological examinations of the James River water at the city intake:

> March, 1910, average number of bacteria per c. c. (medium not stated, presumably gelatin) 3,652; *B. coli* present in 67 per cent of samples in 1 c. c., and in 16 per cent of samples in 0.1 c. c. Maximum turbidity 880; minimum, 8; average for March, 74.
>
> May, 1910, average number of bacteria per c. c., 366; *B. coli* present in 48 per cent of 1 c. c. samples and in 9 per cent of 0.1 c. c. samples. Maximum turbidity, 330; average, 41.

Judging from the observations of the United States Geological Survey (Water-Supply Paper 262), during 1907, 1908, and 1909, stream flows were above the annual mean average during these periods.

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[1] Coast Pilot, Part VI, U. S. C. & G. Survey.

The only sources of considerable infectious pollution from Richmond to the mouth of the river are Richmond, Manchester, City Point, or Hopewell, Petersburg, Smithfield, and Newport News.

Richmond.—Richmond, the capital and principal city of Virginia, is at the head of navigation, 87 miles above Newport News. The city is a railroad center and the site of large tobacco, iron, wood, and other manufacturing industries. With recently annexed suburbs and outlying communities, it has a population of about 130,000 to 135,000.

The sewage, including industrial wastes, is discharged untreated into the James River, either directly or by way of Shockoe Creek, which intersects the city and empties into the river. The amount of the discharge was not known by the city engineer.

The water supply is taken from James River into basins, treated with alum, stored for sedimentation, and treated with liquid chlorine. The necessity for preliminary treatment was shown recently by a sharp outbreak of typhoid fever in a section served by a main into which untreated water had been turned without notice to the health department. The supply, which is good, is examined daily by a resident bacteriologist.

Petersburg.—Petersburg is a city of 24,127 population. Sewage is discharged untreated into the Appomattox River. The State board of health report (1914) states that the water supply is brought from a canal and delivered to sedimentation basins. The water is treated with hypochlorite of lime, and "the results so far have indicated a high efficiency of the plant."

City Point and Claremont.—City Point, or Hopewell, at the junction of the Appomattox and James Rivers, was until recently a small landing and railroad terminus, with a population of 400; within the past few months, however, a large corporation has constructed at City Point a plant for the manufacture of explosives and about 18,000 employees have been brought to the town. The establishment includes a hospital. A modern town with a sewerage system will doubtless be constructed. A large amount of water is used for wash water in the explosives plant, and the waste is said to contain a considerable quantity of sulphuric acid, some of which is neutralized with lime.

Claremont is a small landing and railway terminus 38 miles above Newport News. There is a population of about 630 persons, but no considerable sewage enters the river at that point.

Chickahominy River.—Chickahominy River is an important tributary of the James River, emptying into the latter from the north about 33 miles above Newport News. The river is navigable for vessels of 8 feet draft to Windsor Shades, 23½ miles above its mouth. The stream drains a very sparsely settled country and there is no pollution of consequence.

Practically no pollution, other than agricultural wash, enters the river between City Point and Newport News, except from Pagan Creek, which will be discussed later. (See page 90.)

Collection of samples in James River.—Only one trip was made up the James River to Richmond for the collection of samples. For some time previous to this trip, December 13–16, 1914, there had been heavy rains on the watershed, as a result of which there was an exceptional and unusual flood condition which was evidenced even as far down as Fort Monroe by continued ebb tide and high turbidity. As a consequence of these conditions, the results obtained represent the maximum, rather than the average, conditions of pollution in the river. This is particularly true of the river below City Point, as the flood conditions were not so marked in the river from that point to Richmond, the flood having passed that portion of the river.

Of 44 samples of water taken between Newport News and Richmond on this trip, all showed *B. coli* present in 10 c. c. quantities. Of the 33 samples taken between Deep Water Shoal Light, the upper limit of oyster beds, and Richmond, all (100 per cent) were positive in 10 c. c.; 28 (85 per cent) were positive in 1 c. c.; 20 (60.6 per cent) in 0.1 c. c.; and 11 (33 per cent) in 0.01 c. c.

The five samples which were negative in 1 c. c. were taken below Jamestown Island (about 60 miles below Richmond).

Of 10 samples taken between Richmond and Dutch Gap, 12 miles below, all showed *B. coli* present in 0.1, and 8 in 0.01 c. c. quantities. Of 17 samples taken between Richmond and City Point, just below the junction of the Appomattox and James, all had *B. coli* in 0.1 c. c., and 10 samples were positive in 0.01 c. c.

Of the 12 samples taken below Hog Island over the oyster area, all showed *B. coli* in 10 c. c., but none in 1 c. c. It is interesting to note that at the same upper limit the turbidity suddenly decreased from over 600 to 80 or less, while the saline content increased. Of 9 samples of oysters taken the same day (Dec. 17, 1914), one scored 50 and one scored 32; the others scored low. Both of the samples mentioned came from the upper or seed area. (See table at end of report and map of area.)

During the investigation of this section, which extended over the period from November 25, 1914, to February 9, 1915, 80 samples of water were collected for bacteriological examination, of which 6 showed *B. coli* absent in 10 c. c. quantities; 71, or 90 per cent, were positive in 10 c. c. quantities; 40, or 50 per cent, in 1 c. c.; 21, or 25 per cent, in 0.1 c. c.; and 11, or 14 per cent, were positive in 0.01 c. c. quantities. (See tables at end of bulletin.)

The conclusions reached as a result of this one trip are:

That, at least during periods following heavy rains, the James River from Richmond to Deep Water Shoals, which is the upper limit of seed oyster growth, is heavily polluted with *B. coli*.

That the sudden decrease in *B. coli* is due to dilution, to sedimentation consequent upon the addition of sea water and of retardation of current, the result of tidal changes, rather than to the time factor alone. In this connection it should also be noted that flood tide had set in when the samples from the lower river, negative for *B. coli* in 1 c. c. quantities, were taken.

That the river should be studied over a longer period of time for the determination of the significance and origin of the pollution present, as evidenced by the *B. coli* and total bacterial counts.

Emphasis is to be placed upon the fact that the conditions found were probably the result of an unusual and not an average, or even an annual, flood current.

Pagan Creek and Smithfield.[1]—Pagan Creek is a small tributary which empties into the James River from the southwest, about 7 miles above Newport News. The entrance is about 1½ miles wide, but the channel is narrow and crooked.

Smithfield, a town of about 1,400 population, is located on the south bank of the creek about 4½ miles above its mouth and near the head of navigation. It is of considerable commercial importance and is the center of a flourishing agricultural district. A daily line of steamers and sailing vessels ply between the town and Newport News and Norfolk. There are several other landings on the creek.

The creek at the town is only a few hundred feet wide. Sewage from one-third of the population is discharged by the Main Street sewer directly into the stream. In addition to this source of pollution, about a dozen or more residences on Church Street have private sewers which, with four or five overhanging privies, discharge sewage directly into the stream below the public sewer. A town ordinance requires the cleaning of privies weekly, the contents being hauled into the country.

Dr. Brook, the city health officer, stated that, since the general use of artesian water and the enforcement of sanitary regulations, there has been very little typhoid fever (about three cases per annum) in the town, but that the disease is prevalent among the rural population of the neighborhood. He knew of no cases which could justly be attributed to eating shellfish, the disease occurring in the summer months.

One trip was made for the collection of samples of water and shellfish in Pagan Creek; of nine samples of water taken *B. coli* were present in eight in 10 c. c. quantities, in six samples in 1 c. c. quantities, in two samples in 0.1 c. c., and in one sample in 0.01 c. c. The total counts on agar at 37° were also very high.

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[1] See map No. 13.

The water in close proximity to the town gave visual evidence of serious pollution, and the ebb current is sufficiently swift to carry infectious pollution to the nearest oyster beds, which are about 1 mile below the city. Of the six samples of oysters, those from nearest the town scored 23 with a total count of 500,000. Two samples from near the mouth of the river, not far from a small community, scored 32 and 42, respectively. (See table at end of report.)

The sanitary survey and bacteriological results indicate unsafe conditions, and the upper beds at least should be abandoned. Few, if any, oysters are shipped from these beds within the creek.

Warwick River.—Warwick River empties into the James River about 8 miles above Newport News, and is navigable for vessels of 7 feet draft through a narrow channel about 1½ miles. The upper part of the river has been dammed as a water supply for the cities of Newport News, Hampton, Phoebus, and Fort Monroe. The banks of the stream are sparsely settled, as is the whole of the small watershed. A large part of the river, for about 2 miles on both sides of the channel, is occupied by oyster beds. One trip was made into the river, at which time five samples of water and five samples of oysters were collected. The water showed *B. coli* present in 10 c. c., but not in 1 c. c.; and only one sample of oysters scored as much as 5. The water was very clear, despite high turbidity in the James River and recent rains.

Newport News.[1]—Newport News, an important shipping point about 6 miles west of Fort Monroe, 15 miles northwest of Norfolk, and 21 miles from the ocean, is on the northern point at the entrance from Hampton Roads to the James River and discharges sewage into both bodies of water. The city is the terminus of the Chesapeake & Ohio Railroad, has large grain elevators, coal piers, cotton sheds, and is the site of one of the largest shipbuilding plants in the United States. Its total population is about 25,000, though it varies greatly, as there is a considerable floating population dependent upon the shipyard. A suburb known as "Bloodfield," which contains about 2,000 persons, has also been recently annexed.

Newport News has a complete system of sewers, to which are connected a large proportion of the houses, and further connections are being rapidly made. There are 300 or more houses in the suburbs not connected, of which 70 per cent or more have sanitary closets recommended by the State board of health. Additional sewerage will be installed for the Bloodfield area. At present about 90 per cent of the 30 miles of streets have sewers.

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[1] See maps No. 13 and No. 14.

The topographical conditions are rather peculiar, the city in general being situated on a bluff which slopes downward to the east from near the James River. Owing, in part, to this fact, the sewerage system is divided into three separate units; the untreated sewage being discharged by gravity from three outfalls, two of which are in James River and one in Salter's Creek; in addition, a large amount of sewage is discharged from the shipyard. According to the 1912 report of the State commissioner of health and data courteously furnished by the city engineer, the Thirty-fourth Street sewer is 24 inches in diameter, extends 1,100 feet from the shore line to the main channel of the James River where the water is 50 feet deep, and from it is discharged approximately 45 per cent, or 450,000 gallons a day, of the 1,000,000 estimated total daily city discharge, exclusive of ground water.

The Twenty-fifth Street sewer is 16 inches in diameter and extends out from the shore line about 675 feet, discharging into the river at a depth of about 30 feet. This sewer drains the central congested portion of the city. The daily discharge from this sewer is about 350,000 gallons, exclusive of ground water.

In addition to the effluent from the two above-mentioned outlets, sewage from a small but increasing population north of the shipyard is discharged into the river by a sewer constructed by the Old Dominion Land Co. From 2,000 to 5,000 employees, and numerous vessels at the shipyard, also discharge sewage into the river. The sewage from the eastern section of the city flows by gravity to the outfall which discharges into Salter's Creek about 1,000 feet from the Boulevard electric railway crossing, which is a few hundred feet from the mouth of this sluggish estuary. Formerly there was a lifting pump station by which this sewage was pumped over the divide into the Twenty-fifth Street outfall, but this was abandoned and a main sewer laid to Salter's Creek. About 20 per cent of the city sewage, or 200,000 gallons daily, are said to be discharged into Salter's Creek, and this amount will soon be greatly increased by new lines laid in the recently annexed area. Salter's Creek empties into Hampton Roads.

The water supply for Newport News, Hampton, Phoebus, the National Home for Disabled Soldiers, the Hampton Institute for Negroes, and Fort Monroe, is derived from a common source a few miles above Newport News. The supply is surface water from a carefully policed, forested area. The water from the reservoir is treated with chlorine, examined by a resident bacteriologist, and observed by the medical officer of the army at Fort Monroe; it is an excellent and safe supply. The mortality and morbidity rates of the city have always been very low and compare favorably with those of other cities of the same size. In September, 1914, there occurred a sharp outbreak of typhoid fever due to milk infection.

The health officer, Dr. Pretlow, has histories of seven cases of typhoid fever, due to the consumption during the summer of raw shellfish from Salter's Creek, despite notice against such action. This creek is only from 25 to 50 feet wide, and at ebb tide is virtually an open sewer carrying the above-mentioned 200,000 gallons of sewage. The mouth is only a few inches deep at low water and from 5 to 6 feet or more depth obtains inside for a few hundred feet, above which it is a mere drain.

Nansemond River.—The Nansemond River flows into the southwestern part of Hampton Roads at the mouth of the James River, just opposite Newport News and 5 miles from it, and should be considered in connection therewith. It drains an agricultural section of the county of Nansemond and is the approach by water to the town of Suffolk, the only source of considerable pollution.

Suffolk is a city of 7,008 population, situated at the head of navigation, 17 miles above the mouth of the river. The town is a thriving community with several railroads and with daily steamers to and from Norfolk. It is back from the river landing, and is well sewered, the sewage being discharged untreated into the river. The water supply is furnished by the same company which supplies Portsmouth; it is of excellent quality, and the samitary conditions are said to be good.

One trip was made, October 6, for the collection of samples in Nansemond River. The river above Town Point is narrow, very crooked, and the current sluggish. Of eight samples of water examined, seven were positive for *B. coli* in 10 c. c., and of these two were positive in 1 c. c. but not in 0.1 c. c. One of the 1 c. c. samples was taken near the sewer outlet and one about 1 mile below that point. The nearest oyster beds are 8 miles below the outlet and none of the three samples scored over 4. Few oysters are shipped from this river.

Oyster area in the James River.—The lower part of the James River, on both sides and on the shoals between channels, from about Deep Water Shoals, 14 miles above Newport News, to its mouth comprises one of the important oyster producing areas on the Atlantic coast. According to the Baylor survey, the public grounds cover an area of 26,408.4 acres, of which 12,790.6 acres lie below a line between Days Point and Deep Creek, and 13,167.8 acres above that line. The beds of the former region are available for the production of marketable oysters only, the law requiring that all osyters under 3 inches long be returned to the bed; while the latter region is set apart for the production of seed oysters, and the cull law is not applicable, except in so far as it forbids the removal of shells.[1]

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[1] Condition and Extent of the Oyster Beds of James River, Va., Bureau of Fisheries, Document 729. According to the same authority about 73 per cent of the total area is depleted or barren.

The upper limit for marketable oysters, therefore, is about 6½ miles above the northern sewer outlets of Newport News, and the area extends down to almost opposite that point and on both sides of the channel. In addition to the public grounds described, extensive areas on the south side of the channel and in Warwick River, Pagan Creek, and other tributaries are cultivated under lease from the State of Virginia.

The proximity of this portion of the river to the ocean and the great capacity of the basin compared to the stream flow entering it, together with the long period during which the temperature of the water is suitable, make this region an apparently ideal one for oyster reproduction and growth. The total content of seed oysters present on the bottoms at the beginning of the oyster season, September 15, 1909, was estimated to be 869,937 bushels, the number of marketable oysters (for other than seed purposes) as 98,225 bushels, and the number of young oysters on the marketable ground as 457,476 bushels.[1]

Summary.—The sources of pollution present over the oyster areas of James River may then be summarized as follows:

1. The cities already described.
2. Newport News.
3. Vessels in the roadstead or at the wharves.
4. Pagan Creek and Nansemond River.
5. Hampton Roads, including Newport News, Hampton, Phoebus, Fort Monroe, etc., on the north shore, and Norfolk, Portsmouth, etc., on the Elizabeth River.

Samples of oysters and water from this area were collected November 25, December 4, 13, 17, January 28, and February 9, and the results, therefore, represent the average conditions of temperature, stream flow, and seasonal variations.

In all 46 samples of water and 35 samples of oysters from this section were examined. Of the 35 samples of oysters, 40 per cent scored 14 or more; 34.27 per cent scored 23 or more; 31.42 per cent scored 32 or more; 20 per cent scored 41 or more; and two samples or 5.71 per cent scored 50. Reference to the chart of the locality and to the table shows the locality from which these samples came.

It will be noticed that one of the two samples which scored 50 was taken off Blunt Point, at the southern side of the entrance to Warwick River, and the other one from 100 yards off Jail Island, the northern point at the entrance to the same river. None of the oysters or water from Warwick River showed considerable pollution, and reference to the map shows the probable source of pollution to be the sewers discharging into the channel from Newport News, 4 or 5 miles below the sampling points. Of the five samples which scored 41, two came from the vicinity of Blunt Point and three from White Shoals, a shoal in the middle of the river across the ship channel and about 4½ miles above the shipyard at Newport News.

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[1] H. F. Moore, Bureau of Fisheries, Document 729, Condition and Extent of Oyster Beds of James River, Va.

Of the four samples which scored 32, three were taken on Brown Shoals, which begin about 1 mile above and on the same side of the river as Newport News, and one from Point of Shoals, about 9 miles up the main channel above Newport News.

All of the above localities, except Point of Shoals, are within the section which would probably be reached in one flood tide from the sewer outlets of Newport News. The sample from Point of Shoals was taken immediately after the unusual flood previously described.

Of the 46 samples of water taken, one sample, or about 2 per cent, showed *B. coli* in 0.1 c. c. This sample was from the bar opposite Newport News and a mile or more distant; a high wind had stirred up the mud. Of the nine samples, or 20 per cent, which showed *B. coli* present in 1 c. c., two were taken just off the city front, five from Brown Shoal or the channel nearby, and two from the river on the western side, several miles away and across the channel from Newport News.

So far as may be determined by this investigation it appears obvious that sewage from Newport News now reaches some of the marketable oyster areas in the James River above the city. The proximity of these beds to the outfall eliminates the time factor, which might otherwise purify the water. The volume of water and the consequent dilution in the area are enormous. The main ship channel is more than a mile wide and deep enough for the largest vessels; in addition the volume of water over the beds is great and constantly changing. Nevertheless, the city is growing and will continue to grow northward along the bank of the river nearer the oyster beds, and steps should be taken to continue the investigation and to adopt means to prevent the discharge of raw sewage from the city. Unless such steps be taken the beds of Brown Shoals and vicinity will eventually have to be abandoned as a source of food supply.

In view of the conditions in this area it was recommended that frequent reexaminations be made, particularly a reinvestigation of the area about Brown Shoals and White Shoals, before the oyster season of 1915.

Later inspections.—As a result of the above recommendations and by request of the Governor of Virginia, ten samples of shellfish were collected August 31, 1915, and examined. One sample from the upper end of White Shoals gave the high score of 140 and one from the outer end of Brown Shoal gave a score of 32, all other samples giving low scores. These results agree with those obtained during previous investigations. The State authorities were advised to allow the taking of oysters from all areas except the small White Shoal bed, which should be reexamined.

CONCLUSIONS.

The following conclusions cover the tributaries which enter Chesapeake Bay from the west:

1. Although considerable pollution is present in the Susquehanna River and in that portion of Chesapeake Bay nearest its outlet, at least during periods of heavy stream flow, it is believed that this pollution constitutes no danger to shellfish beds.

2. Shellfish from the immediate vicinity of the entrance to Back River are to be considered as unsafe for consumption as food. This is especially true of clams and oysters gathered during the summer months along the foreshore.

3. In considering Baltimore Harbor, it should be remembered that conditions in both Patapsco and Back Rivers, and consequently in the neighboring waters of Chesapeake Bay, are in a state of transition owing to the construction of a modern sewerage system. The former river is being relieved of pollution; and while the amount of sewage pumped to the disposal plant is being increased, the efficiency of the system is being improved. It is believed that the pollution which reaches the shellfish area is hardly sufficient to constitute any considerable danger of conveying infectious disease, but the study of the area should be continued for a considerable time. The growing of shellfish for food purposes in the above rivers or the foreshores and the taking of shellfish in immediate proximity to summer resorts during the time they are open should be prohibited by competent authority.

4. So long as present conditions are allowed to exist, the taking of shellfish for consumption from the waters of the Severn River between a line drawn from Greenbury Point to the mouth of Lake Ogleton, up to the upper railroad bridge, should be prohibited. However, the State Board of Health of Maryland has recommended a project in outline for a sewage-disposal system which would eliminate the danger of infectious pollution of oysters. Any system to be adequate must include the disposal of sewage from the United States Naval Academy; but so far efforts to secure cooperation have failed.

5. The conditions existing in Spa Creek, a tributary of the Severn, indicate great danger of infection from oysters kept therein. The taking of oysters from this creek should be prevented.

6. The bay west of the channel between the mouth of the Severn and South River, practically one great oyster area, is free from pol-

lution, except from that of two summer resorts. Shellfish should not be taken from the immediate foreshore during the summer season.

7. The oysters taken from the Patuxent River as a whole may be considered safe. No oysters, however, should be taken from the waters immediately around Solomons. During the inspection no oysters were found in proximity to this town.

8. The conclusions reached in regard to the Potomac River in Hygienic Laboratory Bulletin No. 104 were that, with few exceptions, oysters from this river were free from pollution. The exceptions were a small bed in Monroe Bay near the outfall from the sewage-disposal system of Colonial Beach; oyster beds in proximity to a drain at Rock Point, on the Wicomico River, Md.; and oyster beds near a fish wharf and drain at Lewisetta, Va.

9. Although the Rappahannock River itself is safe for the growth of oysters, samples of water taken near the sewer outlet to the town of Urbanna on Urbanna Creek gave evidence of pollution potentially dangerous. However, practically all of the oysters shipped form Urbanna are from perfectly safe beds in the Rappahannock River. Another tributary of the Rappahannock River, Carters Creek, provides a source of potential danger. Few oysters are ordinarily shipped from beds within the creek, though many are used for local trade; on the other hand these beds are used for storing oysters caught in the Rappahannock. The remedy for the conditions found in these creeks would be the adoption by Irvington, Urbanna, and similar towns of sanitary privies. The oyster planters themselves should initiate such measures.

10. The only oyster area near West Point is a small bar below the city between the Pamunkey and the Mattaponi Rivers. Few, if any, oysters are taken therefrom, and the area should be permanently abandoned because of proximity to a sewer outlet. Storage beds in the Mattaponi across the channel one-half mile from the city are safe.

11. Many shellfish beds were found near shore in shallow water in Back River, Harris Creek, and Poquoson River. Whenever surface privies or private sewers exist in the drainage area near by, potential danger is present. In such localities State health organization and local officers should enforce a system of sanitary privies with proper disposal of dejecta.

12. The following conclusions concerning the James River may be given:

(*a*) At least during periods following heavy rains the James River from Richmond to Deep Water Shoals, which is the upper limit of seed-oyster growth, is heavily polluted with *B. coli*.

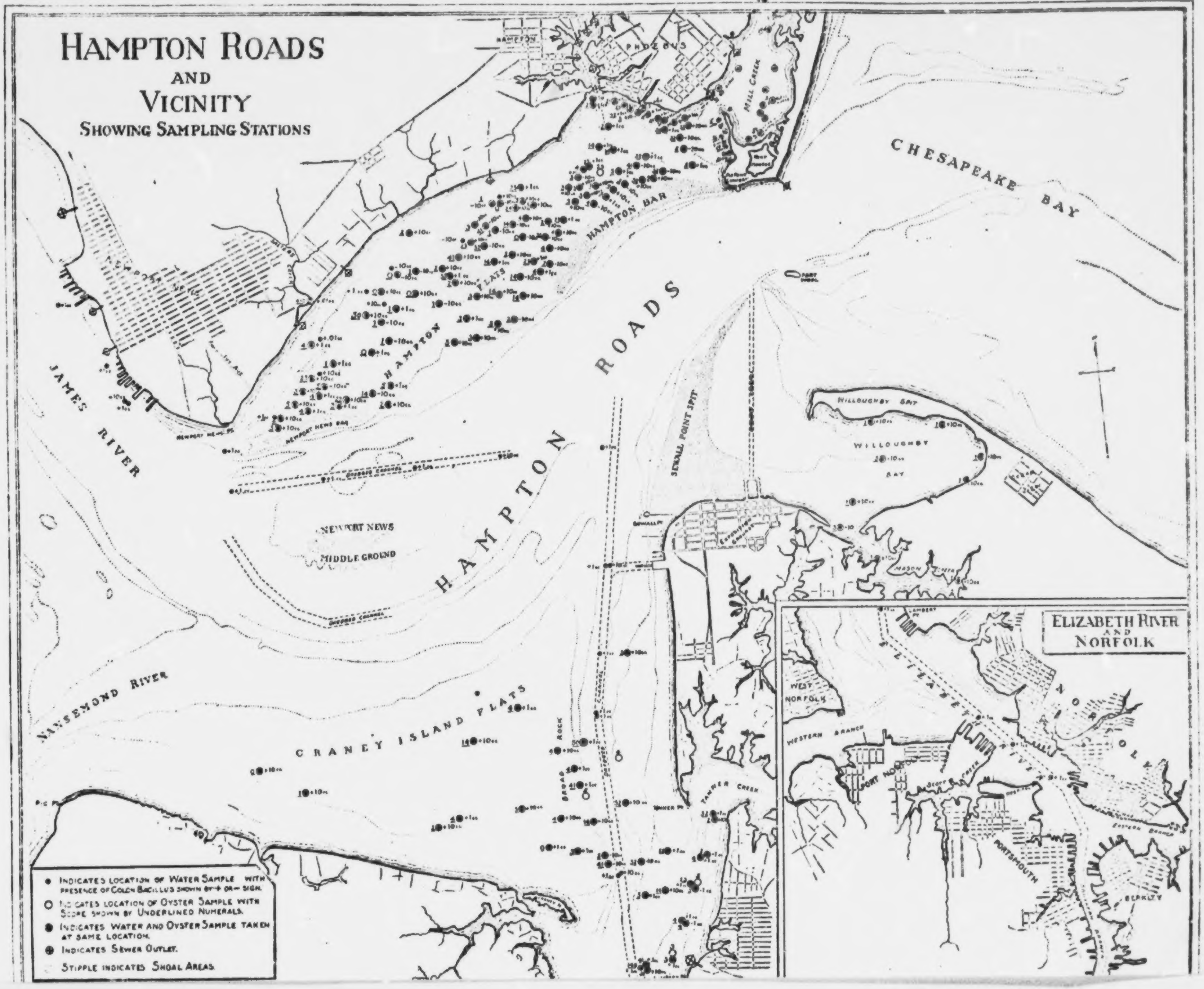
(*b*) The river should be studied over a longer period of time for the determination of the significance and origin of the pollution present, as evidenced by the *B. coli* and bacterial counts.

13. Unsafe conditions exist in Pagan Creek, a tributary of the James River, and the upper beds at least should be abandoned. Few, if any, oysters are shipped from any beds within the creek.

14. Sewage from Newport News now reaches some of the marketable oyster areas in the James River above that city. Furthermore, the city is growing northward along the bank of the river nearer the oyster beds. Therefore, steps should be taken to continue the investigation and to adopt means to prevent the discharge of raw sewage from the city. As a result of a later investigation, the State authorities were advised to allow the taking of oysters from the area about Brown Shoals and White Shoals, with the exception of the small White Shoal bed, which should be reexamined.

Map No 14

HAMPTON ROADS AND VICINITY
SHOWING SAMPLING STATIONS


Hampton
Phoebus
Mill Creek
Chesapeake Bay
Hampton Bar
Hampton Flats
Hampton Roads
Newport News
Newport News Bar
James River
Newport News Middle Ground
Sewall Point Spit
Willoughby Spit
Willoughby Bay
Mason Creek
Nansemond River
Craney Island Flats
Tanner Creek
Broad Rock
ELIZABETH RIVER AND NORFOLK
Norfolk
Elizabeth River
West Norfolk
Western Branch
Port Norfolk
Portsmouth
Berkley
Eastern Branch
● Indicates location of Water Sample with presence of Colon Bacillus shown by + or − sign.
○ Indicates location of Oyster Sample with Score shown by Underlined Numerals.
● Indicates Water and Oyster Sample taken at same location.
⊕ Indicates Sewer Outlet.
Stipple indicates Shoal Areas.

HAMPTON ROADS AND VICINITY.

THE ROADS.

This splendid roadstead and harbor is one of the most important commercial centers and naval and military bases on the Atlantic coast, and is the water approach to the cities of Norfolk, Portsmouth, their suburbs, and the Norfolk Navy Yard on the south, to the cities of Suffolk and Newport News on the west, and to the towns of Hampton and Phoebus on the north, as well as to Richmond, Hopewell, and Petersburg on the James River.

Hampton Roads is at the confluence of the Elizabeth, Nansemond, and James Rivers; in reality it appears to be a continuation of the last-mentioned river, into which the Nansemond and Elizabeth Rivers and smaller tributaries flow. The north shore is a concave line which extends from Old Point Comfort on the east to Newport News Point, a distance of 5½ miles, on the west. On this side are the estuaries known as Hampton Creek and Mill Creek. The eastern limit is 15 miles west of and opposite to the entrance from the Atlantic Ocean to Chesapeake Bay and is defined by a line drawn from Old Point Comfort on the north, 2 miles southward to Willoughby Spit, southwestward to Sewall Point, about 1½ miles, thence south to Tanners Point, thence across the mouth of the Elizabeth River to Craney Island and westward to the mouth of the Nansemond River, from which point to Newport News the distance is about 4 miles. The channel and anchorage for vessels of over 20 feet draft varies from a width of nearly a mile between Old Point and Fort Wool ("Rip Raps") on the east, and of 1½ miles at the western limit to much greater breadths between these points. The anchorage for large vessels continues upward into the James River and varies from 100 feet depth to gradually decreasing depths. At some points the anchorage is interrupted by shoals, including Hampton Bar, a narrow bar 2 miles long, extending from deep water 200 yards west of Old Point in a southwesterly direction; Willoughby Bank and Sewall Point Spit, which converge to meet near Fort Wool; Newport News Bar, near the point of the same name; and Newport News Middle Ground, a shoal about 1 mile long with about 16 feet depth, in the middle of the western area of Hampton Roads. A dredged channel 35 feet deep and 400 feet wide north of the Middle Ground and one 30 feet deep and 500 feet wide south of that shoal lead to Newport News. A dredged channel with 35 feet depth leads southward from the roadstead up the Elizabeth River to the Norfolk Navy Yard.

That segment which lies north of the channel, between a line from Newport News to Old Point and the north shore, is known as Hampton Flats, Hampton Bar being on the eastern and Newport News Bar on the western ends of the chord and near the channel. The shoals south of the roadstead are known as Sewall Point Flats, north and east of Sewall Point: Bush Bluff Shoal extends from Sewall Point, east of the channel to Norfolk, to Tanners Point. The wide area extending from west of that channel to Nansemond River is composed of Craney Island Flats and Nansemond Shoal. That portion of the shoal area embraced within the curved arm of Willoughby Spit is known as Willoughby Bay, into which, to the west of its mouth, discharges Masons Creek from the south.

TIDES AND CURRENTS.

Under ordinary conditions of river discharge there is little difference in duration between flood and ebb tides; heavy stream flow or flood conditions and westerly winds increase the duration of ebb tide, and high northerly and easterly winds increase both the duration and the height of flood tides. The range of tides is from 2 to 4 or even 5 feet under unusual conditions, the average being about 3 feet.

The velocity of the currents in knots is shown approximately by the following data, furnished by the United States Coast and Geodetic Survey:

Velocity of currents near Hampton Roads.

	Flood.	Ebb.
Hampton Roads:	*Knots.*	*Knots.*
[illegible] mile S. 55° W. from Old Point Comfort Light	1.20	1.40
[illegible] mile S. 20° W. from Old Point Comfort Light	1.50	1.70
7[illegible] miles S. 86° E. from Old Point Comfort Light	1.20	1.20
3[illegible] miles S. 40° W. from Old Point Comfort Light	1.20	.90
James River off Ship Building Co.'s wharf	1.46	1.16

In Hampton Roads the tidal currents do not correspond to the tides of high and low water. In the south channel to Newport News the ebb continues to run about 1 hour 15 minutes after low water, while in the north channel it runs about 20 minutes after low water.[1] There is a much lower velocity on the flats, and conditions vary greatly in different parts of the Roads; for instance, the tides turn in the channel inside Hampton Bar about 30 minutes before the tides turn only a few hundred feet distant in the main channel. The local differences are factors of importance in determining the questions of the source and extent of pollution over different areas. During ebb tide there is everywhere a convergence of waters from tributaries and flats to the greater velocity of the main channel.

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[1] Tide Calendar, Hydrographic Office, Norfolk, Va.

The water from Elizabeth River (bearing the largest proportion of sewage discharged into the Roads) is constantly forced against the east bank by the ebb tide from the James and Nansemond Rivers; this may be seen by the tide rip, and the result is shown on the map by the Craney Island Flats. The great volume of water from the James River, sweeping around a curve, follows the main channel of the Roads, sedimentation taking place where the currents from the Nansemond and Elizabeth somewhat oppose and retard it.

The practical effect of this condition is that it is quite improbable that much sewage polluted water from the Elizabeth River reaches further than the edge of the channel to the west, or Craney Island and the Broad Rock oyster areas. Tanners Creek empties on the east side in a peculiar manner, the mouth being pointed upward instead of downstream. About a mile above this point the great piers of the Norfolk & Western Railroad Co. extend to the channel, and just below them is the Pocohontas Avenue sewer of Norfolk.

The net result of these influences is that the waters from the Elizabeth River follow a straight narrow channel down to the north side of deep water in Hampton Roads, where they join the ebb tide from the James River about 3 miles above the junction of Hampton Roads and Chesapeake Bay. The velocity of the current at that point is about 1.89 nautical miles an hour, so that all except the last 1½ hours of ebb flow from the Elizabeth is swept into the Chesapeake Bay, and the last 1½ hour's flow is swept back by flood tide coming into the Roads. On the north side currents are likewise of practical sanitary importance, though there are no large tributaries.

Salter's Creek, which as before described receives considerable sewage from Newport News, discharges its small volume directly upon Hampton Flats, 1 mile below Newport News Point, where the tidal current is very slow. No float tests were practicable on account of the shallow water; but laboratory results show that the water from this source finds its way over the upper part of the flats, between Newport News and Hampton Bars, to the main channel. The waters from the water front between Newport News and Hampton, above the upper end of Hampton Bar, also seem to converge toward the main channel. Below this line, however, they seem to drift more directly along the shore over the flats to meet the outcoming waters from Hampton Creek, the combined waters flowing between Hampton Bar and the shore to meet the water from Mill Creek near Old Point and join the main channel through the narrow waterway between Old Point and the lower end of Hampton Bar, only a few hundred yards above the outlet into Chesapeake Bay. As the tide turns in this inside channel 30 minutes before it turns in the main channel, the first ebb from inside the bar joins the last of the flood in the Roads;

however, before it reaches the upper end of the bar, ebb begins in the main channel.

Flood tide brings into Hampton Roads what is practically unpolluted sea water from the ocean, 15 miles distant, in addition to that small part of the enormously diluted waters from Hampton Roads which are not carried up the bay by the flood tide. Flood tide waters, here as elsewhere, constantly tend to diverge and expand over the adjoining shoals and up the tributaries; the shoals of Hampton Roads have an important effect upon these conditions. The Sewall Point Bar and the land to the east of the Elizabeth River and the area below, down to Sewall Point, prevent much lateral pushing westward over Craney Island Flats of the last ebb tide waters from that river; and the current, running almost directly southward, tends to return these waters into the river, Norfolk Harbor, and its various tributaries. The wide, funnel-shaped mouths of the James and Nansemond Rivers receive almost all of the upward thrust of flood tide.

On the north side the flood tide would appear to diffuse and spread over the flats that part of the ebb flow from Hampton and Mill Creeks which had not reached the main channel. The currents of this area should be studied exhaustively, by float observations and laboratory examinations of water and bottom mud.

TRIBUTARIES.

Separating that part of Hampton Roads north of the main channel from Chesapeake Bay is a low sandy peninsula known as Old Point; connecting this area with the mainland beach to the northeast there is a narrow strip of sand known as the "Beach"; running from the northwest portion of Old Point is a causeway which ends a few hundred feet from the town of Phoebus; bridges connecting the two communities have been built over a narrow strait which connects Hampton Flats with Mill Creek.

Old Point Comfort is a military reservation, the larger portion of which is occupied by the great fortress and dependent modern batteries known as Fort Monroe; there is also a large hotel, the Chamberlin, and a smaller hotel. The population of the reservation is a fluctuating one, being dependent upon military movements and guests at the hotels. During the summer months the number is augmented by organizations from other military posts sent for target practice. The average population is about 2,000.

A complete sewerage system, built on the separate plan, connects all permanent structures to an intake well which has a capacity of about 235,000 gallons; from it sewage is pumped twice daily, beginning shortly after ebb tide sets out. The outlet pipe extends into deep water near the southeast point and the sewage is swept into

Chesapeake Bay. This sewage, amounting to about 450,000 gallons a day, is a negligible factor in the pollution of Hampton Roads. Troops camped on the Beach during the summer months are provided with dry closet systems with incinerators.

Mill Creek.—Mill Creek is a quadrilateral-shaped, shallow body of water with an area of about 1½ square miles, almost surrounded by Old Point, the Beach, the causeway, and the mainland. The depth at low tide varies from a few inches to a few feet. The sources of pollution are Buck Roe Beach, a summer resort on the Bay side, from which there is a little sewage, St. Joseph's School, with a private sewer, and the town of Phoebus. There are also several outfalls for sewage from batteries on the Beach which are used intermittently.

Phoebus is an incorporated town which had in 1910 a population of 2,394, in addition to the floating population. The town has public sewers, which discharge untreated sewage into Mill Creek.

> The sewerage system is incomplete. At present there are two units, the sewage flowing by gravity to two outfalls. Plans are under way for the addition of another unit within a year or two. One outfall discharges into Mill Creek at the foot of Mellen street. This serves the main part of town and is connected with 7,700 feet of sewers. The other outfall is connected with 7,000 feet of sewers. which serve the northeastern section of town, and discharges into Mill Creek about 3,000 feet northeast of the first outfall.[1]

About 20 per cent of the houses are not connected with the sewerage system but use ordinary privies.

The Mellen Street sewer outfall is only about 200 feet above the bridge, in plain view, and along side the landing of an oyster shucking house. Several other shucking and shipping houses are in the immediate neighborhood, and there are private oyster beds nearby. This condition is an advertisement and a warning to visitors who cross the bridge, a reflection upon the intelligence of the community and all those responsible for it. It is also unjust to those intelligent shippers who do not handle such oysters, but who have their establishments in that section of Virginia.

As a result of the sanitary survey and the examination of 16 samples of water and 16 samples of oysters taken from Mill Creek November 13, 14, and 30, the State authorities were advised to forbid the taking of oysters from certain sections of Mill Creek which showed danger of infectious pollution. Of the above samples, 11 samples of water showed *B. coli* in 10 c. c., 6 in 1 c. c., and 1 in 0.1 c. c. Of the 16 samples of oysters, 6, or 42.5 per cent, gave scores of 41 or more and 3, or 21 per cent, gave scores of 50.

The National Soldiers' Home for Disabled Volunteers lies immediately to the west of Phoebus at the entrance to Hampton Creek and overlooking that part of Hampton Flats east of the channel to Hampton. The population consists entirely of old disabled soldiers and the administrative staff, and sanitary conditions are excellent. The water supply is derived from the Newport News Company and, as previously stated, is excellent. There is a complete sewerage system on the separate plan; this system is divided into three units, each of which discharges into a collecting well, from which the sewage is pumped through outfall pipes on to Hampton Flats. One outfall is located a few hundred feet south of the mouth of Hampton Creek, and the other two from the southeastern point of the grounds.

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[1] Annual Report, Commissioner of Health of Va., 1912.

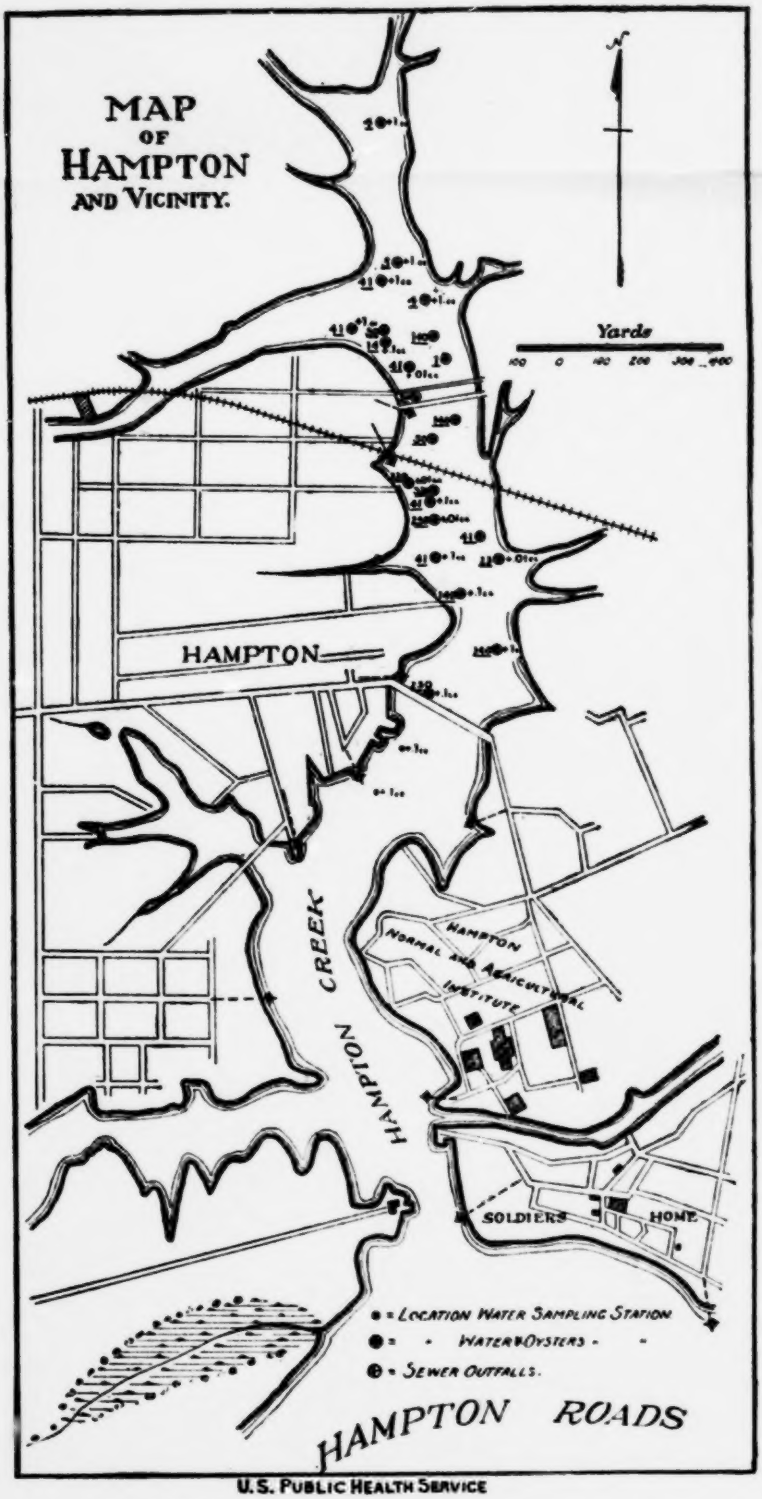
The population varies from 2,500 to 3,000 or more persons and the daily flow is from 175,000 to 200,000 gallons per day. Formerly, this sewage constituted a menace to the oyster beds of Hampton Flats east of Hampton, but there have recently been installed a liquid chlorine plant at each of the collecting tanks. Probably as a result of insufficient disintegration and the construction of the intakes and pumps, the treated effluent showed a rather high *B. coli* content during the examinations made by this service. Changes in construction have been suggested by Sanitary Engineer Hommon, Public Health Service, and it is believed that satisfactory results will be obtained upon completion of these changes. The plant is under competent supervision.

Hampton Creek.—Hampton Creek discharges through a narrow mouth, only 300 or 400 feet wide, into Hampton Roads, about 2 miles northwest of Old Point and 1 mile west of Mill Creek. The creek runs northward for about three-fourths mile, then turns northeast and extends about 1 mile, the width varying from one-half to three-fourths of a mile; there is a prong on the east (Jones Creek), and a larger one on the west (Sunset Creek) just inside the mouth, and a large prong (Brights Creek) near the head. Hampton Creek receives pollution on both sides from the mouth to near the head of the creek.

Hampton is an incorporated town which had in 1910 a population of 5,505; including suburbs there are probably about 7,000 inhabitants. It extends from the banks of Sunset Creek along the western and northern shore of the creek to Brights Creek, near the head of Hampton Creek, and includes a considerable population on the opposite side of the creek. Hampton is one of the most important oyster, fish,, and crab centers in the United States and, with Old Point, is the shipping, shopping, and banking center for a prosperous and thickly settled rural back country. The public water supply is almost exclusively used and is derived from the Newport News Company.

104a

MAP No. 15.


MAP OF HAMPTON AND VICINITY.
N
Yards
100 0 100 200 300 400
HAMPTON
HAMPTON CREEK
HAMPTON NORMAL AND AGRICULTURAL INSTITUTE
SOLDIERS HOME
● = LOCATION WATER SAMPLING STATION
● = " WATER & OYSTERS " "
⊕ = SEWER OUTFALLS.
HAMPTON ROADS

U.S. PUBLIC HEALTH SERVICE

17132°—Bull. 74—16. (To face page 104.)

The following description of the sewerage system is taken from a report made February 9, 1915, by George W. Fuller of New York, consulting engineer to the town council of Hampton:

> The existing sewer system comprises approximately 8 miles of vitrified pipe sewers, mostly 8 inches in size, but with some 10-inch and 12-inch pipe. The sewers receive only domestic sewage, with the exception, however, of a number of street inlets on King Street, Queen Street, and Armistead Avenue. There are also a few roof-water connections at the head of certain lines for flushing purposes.
>
> There are five separate districts, each draining to its own outfall, the details of which are tabulated:
>
> *Hampton sewage system.*
>
> | Location of outfall. | Size of outfall. | Tributary area. | Length of sewer. |
> |---|---|---|---|
> | | *Inches.* | *Acres.* | *Feet.* |
> | East Queen Street | 12 | 130 | 17,000 |
> | Victoria Avenue | 12 | 100 | 12,000 |
> | South King Street | 10 | 15 | 2,000 |
> | Mallory Avenue | 12 | .... | .... |
> | Elm Avenue | 10 | 75 | 7,000 |
> | East Side | 8 | 20 | 2,000 |
>
> While the larger portion of the city is reasonably well served by the existing system, there are many residences and business houses situated along the water front which have private sewers discharging directly into Hampton River and its numerous small inlets. There is also quite an area along the northern and western boundaries of the city which is not tributary to existing sewers on account of the elevation of the ground. This section comprises the poorer neighborhoods where the use of privies is customary and where the installation of plumbing is often considered to be beyond the means of the householders.

There are said to be about 580 licensed connections to public sewers; but there are probably about 800 or more houses from which sewage is discharged into the Hampton Creek, including a large general hospital, "Dixie Hospital," in addition to which there is considerable pollution from numerous vessels.

Along the water front is one of the largest and best equipped oyster shucking establishments in the country, with several smaller ones and three or four crab packinghouses. Considerable organic matter reaches the water from these establishments, though it has been sterilized in the proc[illegible] preparing crabs.

The total amount [illegible]e emptied into the creek from Hampton is probably abou[illegible],000 to 250,000 gallons a day, exclusive of ground water, [illegible] the outfalls are distributed along its course. Evidences of [illegible]s pollution may be seen at various places, notably near the foo[illegible] King Street and the outfalls on either side of Queen Street E[illegible] Oyster beds occupy nearly all of the bottom from the latter [illegible] to the head of the creek. All of the beds are leased and the a[illegible]s [illegible]vided into many small holdings.

A float wa[illegible]d adrift at the junction of Bright's Creek with Hampton Creek at 10.55 on the morning of December 3, 1914, about two hours after high water, and allowed to drift until the beginning of the flood tide at 3 p. m.. A fresh northeast breeze was blowing at the time which would increase the speed downstream, as the general trend of the creek is southwest. During the run the float covered a distance of about 1½ miles in four hours; that is, it floated from near the uppermost oyster beds down the channel and to within 200 yards of the mouth of the creek.

On the morning of December 11, 1914, a float was dropped off the dock of the Old Dominion Steamship Co., at 8.45, about three-quarters of an hour before the flood tide. The float drifted about 100 yards down the creek before the incoming tide caught it and carried it upon a mud flat opposite the starting place, necessitating its being towed out to midstream where the tide carried it about 1,200 yards upstream before it again ran aground on a mud flat at the end of the Chesapeake & Ohio Railroad bridge. Again being towed to midstream it continued up the creek for about 175 yards before the ebb tide started it on its return. The ebb tide carried it downstream for about 600 yards and into a side creek that discharges just above Hampton Bridge. The time consumed in the upstream drift was about 5½ hours and the downstream drift was of about 3 hours' duration. Judging from these tests and other observations it is evident that sewage from nearly all of the outfalls is carried over the oyster beds.

November 10, 11, and 17, 1914, 23 samples of oysters, representing conditions on all of the beds and 17 samples of water from over the beds were collected for examination. Of the 23 samples of oysters 17, or 74 per cent, scored 41 or more; 10, or 43 per cent, scored 50 or more; 8, or 35 per cent, scored 140 or more; 4, or over 17 per cent, scored 230 or more.

These results, together with the topographical study, left no doubt that oysters from such a source were unfit for human consumption unless they were transplanted to waters suitable for self-purification. The State and Federal authorities were so informed. Prompt action was taken by the State authorities, and a meeting of the oyster bed lessees was called, at which representatives of the board of health, State dairy and food division, and State commissioner of fisheries were present, as well as a representative of the Public Health Service, by invitation. The planters were notified not to remove oysters except for transplantation and the Commissioner of Fisheries, who was present, detailed the local oyster inspector to enforce the order in both Hampton Creek and Mill Creek.

The city council immediately invited Surg. Cumming to confer with them as to remedial measures, and they were advised to secure the services of a competent sanitary engineer. As a result the services of Geo. W. Fuller, of New York, were secured, and plans have been submitted by that firm which provide for the collection of sewage at the existing outlets and pumping to a central disposal plant where it would be subjected to sedimentation and sterilization, and for the discharge of the purified effluent by gravity into the southwest prong of Back River, several miles above the nearest oyster beds. This matter is still under consideration.

The Hampton Normal and Agricultural Institute, a large institution for the education of negroes and Indians, occupies all of the eastern bank of the creek from Jones Creek opposite the Soldiers' Home to opposite King Street Wharf. The grounds occupy an area of 185 acres, on which are about 120 buildings, and the population varies from 1,000 to 1,500. The sewerage system is complete and is built on the separate plan, storm drains and gutters having been provided for surface water. The main sewer varies from 12 to 16 inches in size and is of cast iron with tile laterals.

The sewage, which averages from 70,000 to 100,000 gallons per day, flows by gravity to a collecting chamber, from which automatic electrically operated pumps lift it to two concrete storage tanks each of 50,000 gallons capacity. The bottoms of these tanks are 7 feet above high-water level, and they are connected by by-passes. These tanks are emptied at the beginning of ebb tide through a discharge pipe with the outfall near the mouth of Jones Creek.

In 1912 the engineer of the Virginia department of health installed a hypochlorite of lime plant and conducted experiments upon the disinfection of this effluent. At the time of this investigation, however, the sewage was being discharged untreated and constituted an additional menace to the near-by beds on Hampton Flats. Upon recommendation of officers of the Public Health Service a liquid chlorine plant has been installed and thus the effluents, both from this source and from the National Soldiers' Home should no longer be a source of danger to near-by oyster layings.

North shore of roads.—The north shore of Hampton Roads, from the mouth of Hampton Creek westward to Salters Creek at Newport News, is indented by several small estuaries but is generally high and eminently suitable for residential purposes; as a result quite a number of residences and a large general hospital have already been built, and the shore line and near-by areas along the car lines are rapidly being populated. A public sewer has already been constructed by a land company, which at present serves only a few houses, and there are many private sewers, including the one from the hospital, which discharge directly into Hampton Roads. The amount of sewage is now small but fresh and will increase with the population. Residences away from the shore line, particularly in the western section, use cesspools or privies.

OYSTER BEDS.

As previously described, Hampton Flats comprise that segment of Hampton Roads between a line from Newport News Point to Old Point and the north shore, an area of about 7 squares miles, or 4,500 acres. With the exception of Hampton Bar and Newport News Bar, the bottom slopes gradually for about 500 feet out, where the depth of water varies from 10 to 15 feet until it drops abruptly at the main channel. The even and moderate depth, the absence of ice, the influx of sea water with each flood tide, and the abundance of food brought by ebb tide combine to make this area very valuable oyster ground; and the oysters from this area, known as "Hampton Bars," have always been highly valued. About 3,500 acres are leased by the State to individuals at $1 an acre, and they are cultivated to the limit of their capacity. Seed oysters are brought from James River or elsewhere, and steam or gasoline power dredges are generally used by the larger planters.

That the Hampton Flats oyster industry is an important one to the Commonwealth, and especially to the people in Hampton and vicinity, is indicated by the following:

Estimated average yearly expense:	
1. Labor in gathering and marketing of oysters (this includes the dredging, tonging, shucking, packing, etc	$59,600
2. Labor in planting seed oysters, which includes boat hire and labor for catching	53,000
Total	112,600

That a considerable number of people depend for a livelihood on the oyster industry is shown by the fact that between 500 and 600 laborers are employed. At least 95 per cent of these people live in Hampton or the immediate vicinity.

The following statistics were prepared October, 1915, for the town council in connection with the consideration of the question of construction of a sewerage system and disposal plant:

Estimates on oysters, clam, and crab industry in Hampton.

Gross sales of oysters for one year	$390,000
Gross sales of clams for one year	50,000
Gross sales of crabs for one year	500,000
Total	940,000
Invested in plant oysters, oyster grounds, houses, boats, and equipments	674,000

This does not represent the money spent by outside oyster boats that come into Hampton for provisions, nor does it represent the money collected by the railroad company for freight on oysters and clams, as these are sent collect by the shippers.

In view of the importance of this area, because of the extent and value of the oyster industry, the wide interstate shipment of oysters

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[1] Report of State Commissioner of Health, 1912.

therefrom, and the many sources of possible infectious pollution, an intensive study was made of this section of Hampton Roads. The investigation covered a period between October 1 and December 17, 1914, with temperature of the water ranging from 15° to 28°, and therefore represented average as well as exceptional conditions.

Of 105 samples of oysters collected from all parts of the area, three samples, or 2.85 per cent, gave a score of more than 50; one sample, however, came from up Salters Creek, near the railroad bridge; there were no oysters planted there, and the local health authorities have repeatedly issued warnings against eating any shellfish from that locality. No oysters are shipped therefrom, and this sample should be disregarded. Of the samples taken from Hampton Flats, only two, or 1.9 per cent, showed a score as high as 50, and one of those was taken 300 feet outside of the mouth of Hampton Creek, across the channel from but near the outlet of the Soldiers' Home sewer. No oysters are planted there, and there were very few found in that vicinity. This sample may be disregarded, except as a possible warning that the taking of clams and oysters from such places should be forbidden. The other oyster sample which gave a score of 50 is of more significance. The location of the sampling station was "Buxton Hospital, N. N. W., mouth of Salter's Creek W., Chamberlin Hotel, E. by N." A study of the chart will show that this pollution probably came from Salters Creek or one of the nearby private sewers. The tide was ebb, and the corresponding sample of water gave *B. coli* positive in 10 c. c., but not in 1 c. c.

Of the six samples of oysters, or 5.7 per cent, which gave a score of 41, two were collected close inshore, and one about the middle of the triangular section of the flats between Hampton Creek channel and Mill Creek. The water sample with the last-mentioned oyster sample gave *B. coli* absent in 10 c. c. The samples of water taken with the two inshore samples gave *B. coli* present in 1 c. c. Of 14 samples of water taken on the shallow flats along this area in front of the Soldiers' Home and Phoebus estate, 10, or 71 per cent, gave *B. coli* present in 1 c. c.; 3, *B. coli* present in 10 c. c., but not in 1 c. c., and only one absent in 10 c. c.

These results show a large amount of pollution and were to be expected, for some sewage from Hampton Creek and the Soldiers' Home is carried over the beds east of the creek. In addition to the above samples eight samples of oysters taken below the Mill Creek bridge along the shore between the causeway and the channel from Mill Creek, one gave a score of 50 and one a score of 41. There are two possible sources of this pollution: Mill Creek with Phoebus sewage, or the surface water from the Quartermaster's stables nearby.

Of 104 samples of water taken with oysters, 37, or 35.23 per cent, gave *B. coli* in 1 c. c.; 40, or 38.09 per cent, gave *B. coli* in 10 c. c., but not in 1 c. c.; and 27, or 26 per cent, showed those organisms absent in 10 c. c. quantities.

Summary of conditions found on the Hampton Flats oyster area.—The apparent sources of pollution over the area are:

1. Fort Monroe.
2. Phoebus.
3. National Soldiers' Home.
4. Hampton Normal and Agricultural Institute.
5. Hampton.
6. Sewers from houses and hospital along the shore between Salter's Creek and Hampton.
7. Salter's Creek outlet from Newport News.
8. James River sewer outlets from Newport News.
9. Shipping in the harbor.

The sewage from Fort Monroe may be eliminated, because of the excellent method of collection and pumping into the Bay. The two institutions which constituted together sources of considerable danger have voluntarily installed disinfecting plants which, properly conducted, will remove the danger.

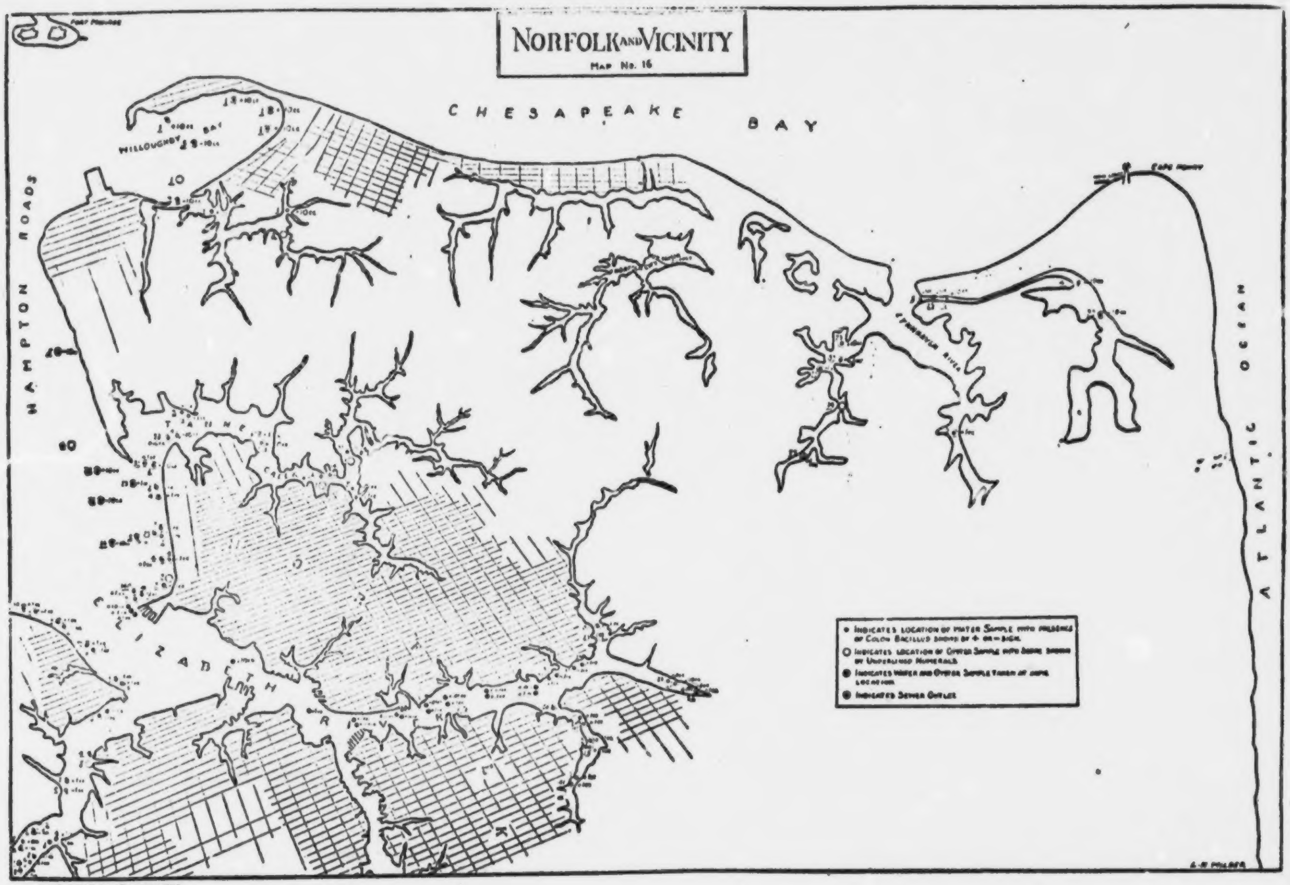
Hampton and Phoebus continue to discharge sewage sufficient in quantity to make necessary the condemnation of oysters from Hampton Creek and a part of Mill Creek; moreover, and this aspect is the more serious of the two, it is evident that sewage from these sources constitutes a constantly increasing source of pollution to those beds on Hampton Flats which lie eastward of the entrance to Hampton Creek. It is a question of a short time only before these beds must be condemned, unless steps are taken to remove the danger.

The private and corporate sewers along the shore between Hampton and Newport News discharge a small but increasing quantity of raw sewage, the effect of which is not noticeable as yet except along the shore line. There is, however, increasing danger from these sources, and steps should be taken to eliminate the danger by the construction of an interceptor, with a collecting tank and disinfection, or by compulsory substitution of other methods of disposal.

The Salter's Creek outlet is at present a serious menace to the continued use of the upper oyster beds, and this menace is increasing. There appear to be no engineering difficulties in providing a method for the disinfection of the sewage from this outfall. If the present method of discharging raw sewage from this source be continued, the condemnation of a larger area of polluted oyster beds will inevitably follow.

The sanitary engineer of the State board of health of Virginia submitted a report upon a sanitary survey of this whole area, which was published in the report of the commissioner of health in 1912. No action apparently has followed his recommendations, which in general are indorsed as a result of the present examination.

110a



NORFOLK AND VICINITY

MAP No. 16

CHESAPEAKE BAY
ATLANTIC OCEAN
HAMPTON ROADS
WILLOUGHBY BAY
LYNNHAVEN RIVER
CAPE HENRY
FORT MONROE
TANNER
ELIZABETH
● INDICATES LOCATION OF WATER SAMPLE WITH PRESENCE OF COLON BACILLUS SHOWN BY + OR − SIGN.
○ INDICATES LOCATION OF OYSTER SAMPLE WITH SCORE SHOWN BY UNDERLINED NUMERALS.
● INDICATES WATER AND OYSTER SAMPLE TAKEN AT SAME LOCATION.
● INDICATED SEWER OUTLET

[illegible] (To face page 110.)

In reviewing the situation it will be noted that sewage from the property of the United States, both at Fort Monroe and the Soldiers' Home, and sewage from the Hampton Institute, which is maintained in large part by funds from sources outside of Virginia, have been eliminated as sources of danger. None of these places have any pecuniary interest in the sanitary condition of the oyster beds.

Newport News and Phoebus have taken no action toward alleviating conditions; on the contrary, the former city is contemplating the increased use of Salters Creek. The city of Hampton, whose residents are more vitally concerned in the protection of the beds, has taken enough interest in the matter to secure the services of an eminent engineer and it is hoped that his advice will be followed. The political subdivision of what really constitutes one community makes local action difficult. Phoebus, Hampton, and Newport News are incorporated communities; between Hampton and Newport News, and along the northeast shore of Mill Creek, the County of Elizabeth City has jurisdiction. The situation seems to be one demanding action by the State of Virginia, if these valuable grounds from which it derives such a large direct and indirect revenue are to be preserved for the benefit of her citizens.

Willoughby or Broad Bay is that shallow portion of Hampton Roads which is embraced by the hook of Willoughby Spit, opposite Old Point. There are 100 or more residences on the Spit, but, so far as could be ascertained by personal inspection along the shore, no sewer emptied into the bay, cesspools being employed and the sand sed for drainage. Samples of oysters and water from this section owed the area free from pollution. Of 8 samples of each taken ong the shore and over the beds, 3 gave *B. coli* absent in 10 c. c., 5 ere positive in 10 c. c., but not in 1 c. c. No sample of oysters cored over 5.

Masons Creek is an estuary with small drainage area which discharges into Willoughby Bay on the south shore near its mouth. During the summer season a sewer, which receives sewage from the pavilion at Ocean View, discharges into a small eastern prong of the creek; but no pollution was shown over the beds at the time of inspection, three samples each of oysters and water showing *B. coli* present in 10 c. c. only, and the oysters scoring 2 and 1.

ELIZABETH RIVER.[1]

GEOGRAPHICAL SKETCH.

The Elizabeth River, which empties into Hampton Roads from the south, is the approach to the cities of Norfolk, Portsmouth, the United States Navy Yard near Portsmouth, the Naval Training Station, Marine Barracks, the terminals of the Norfolk & Western Railroad at Lambert Point, and to West Norfolk and Port Norfolk, with the terminals of several railroads. Into the South Branch open the Chesapeake and Albemarle, and Dismal Swamp Canals, which afford communication by water with the inland waters and coastal sounds of North Carolina. Vessels of 35 feet draft can go to the navy yard on the South Branch, and to the coal piers at Sewall and Lambert Points. A draft of 8 or 9 feet can be taken through the canals.

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[1] See maps of Norfolk and vicinity and Hampton Roads, maps No. 14 and No. 16.

Tanners Creek discharges into the eastern shore, about 1½ miles north of Lambert Point and 3 miles south of Sewall Point; Craney Island being west of the channel and nearly opposite. Tanners Creek has a depth of from 9 to 22 feet in the channel for about 3 miles above the mouth, which, however, is obstructed by a bar with 6 feet of water over it.

Tanners Point so overlaps the mouth from the north side that the entrance is from the south. About a mile above its entrance the creek divides into a north, east, and south prong, the latter reaching into the suburbs of Norfolk.

Elizabeth River has three branches, all of which have smaller tributaries.

Western Branch.—The Western Branch makes in westward about one-half mile south and on the opposite side from the Lambert Point terminal piers; it has a narrow channel with 20 feet depth to the wharves at Lovetts Point ("West Norfolk"), and 15 feet to Port Norfolk on the opposite bank. There are several drawbridges and a draft of 8 feet can be carried about 3½ miles above the mouth. Above the settlements around the entrance the banks are occupied by highly cultivated truck farms, on which enormous quantities of manure are used. The Elizabeth River between Lovetts and Lambert Points is about 1 mile wide and gradually narrows.

Eastern and Southern Branches.—About 7 miles above Sewall Point and 3½ miles above Craney Island the river bends eastward and continues as the Eastern Branch, for about 3 to 4 miles, while the Southern Branch continues in the general line of the river. The river at this junction is only 600 to 800 yards wide; the Eastern Branch is from 500 to 600 yards wide and quite deep for about 1½ miles.

The city of Norfolk extends along the east bank of the Elizabeth River from 1 mile below the junction of the branches to over 1 mile along the north shore of the Eastern Branch. It also extends across the latter to include the former town of Berkeley, lying along the south bank of the Eastern Branch and east bank of the South Branch. Adjoining Berkeley on the south is the Naval Training School, opposite which are the United States Navy Yard and Marine Barracks. Extending northward along the west shore of the South Branch and Elizabeth River to Scotts Creek, for 1½ miles, is the city of Portsmouth.

Norfolk and Portsmouth.—Norfolk is a thriving commercial city with a large foreign and coasting trade employing many lines of steamers and sailing vessels. There are frequent ferry communications with Portsmouth, Berkeley, Newport News, and Fort Monroe, and the harbor is nearly always crowded with shipping. Portsmouth is a city of considerable size and commercial importance, with a railroad terminus and a large cotton shipping trade.

The population of Norfolk in 1890 was 34,871, in 1900, 46,624, and in 1910, 67,452; that of Portsmouth 13,268 in 1890, 17,427 in 1900, and 33,190 in 1910. The population of the navy yard and training station varies with the number of vessels at the yard and the drafts sent out from the training station. It is probable that the present aggregate population, contributing pollution to the Elizabeth River, is not far from 125,000. The sewerage system of the older and more congested portion of Norfolk was designed many years ago by Col. Waring. The trunk sewers discharge by gravity into collecting tanks, from which the sewage is pumped untreated into the Eastern Branch and Elizabeth River. The city engineer stated that the system handled an enormous amount of ground water, and that it is not practicable to estimate the total amount discharged. The approximate location of outfalls is shown on the map of this vicinity. At present the larger proportion of sewage is from the outfall into the Eastern Branch below the Norfolk & Western Railroad bridge. The city is growing most rapidly northward and westward, and the Pocahontas Avenue sewer, which discharges just below the Lambert Point piers, will eventually receive far greater amounts than at present. This outfall, owing to its contiguity to the oyster beds, is a source of danger. All of the cities discharge sewage untreated into the nearest part of the river and it is probable that approximately 7,000,000 gallons per day are so discharged.

The average range of tide above mean low water is from 2 feet (neap tides) to about 3½ feet (spring tides).

FLOAT TESTS.

It is difficult to make float observations, because of the amount of shipping and various docks and estuaries, but the following are examples of results obtained in the Elizabeth River:

1. A float was turned adrift in the Eastern Branch of the Elizabeth River at the Norfolk & Western Railroad bridge at 6.10 o'clock on the morning of November 28, 1914. A light breeze from the northeast was blowing at the time, but about 8 o'clock freshened up a little. The float was liberated at the beginning of the ebb tide, and was allowed to proceed through the course of this tide and about three hours of the flood, when it was picked up.

From observations taken at intervals of 30 minutes the float appears to have quite consistently followed the channel through the Eastern Branch and into the Elizabeth River until it reached Hospital Point, which lies just above the mouth of Scotts Creek. Here the float developed a tendency to work toward the western shore of the river and, after it had passed the mouth of Scotts Creek, grounded on the mud flat below the mouth of the creek, and had to be towed out to mid-channel. The float then drifted about 25 yards in a downstream direction, but setting toward the western shore all the time. Again it ran aground and had to be towed out to mid-channel. The tide turned about this time and the flood tide carried the float in a direct line up Scotts Creek, where it again grounded and was towed out to mid-channel, when the full force of the flood tide carried the float directly up the channel until it was picked up at the end of the run.

The distance from the Norfolk & Western Railroad bridge to the mouth of Scotts Creek is about 2 miles, and the float consumed about 6½ hours in covering this distance. Had the float kept to the channel and received the full force of the ebb tide, it would doubtless have continued about one-half mile farther down the river before the incoming tide forced it back. Under the influence of the flood tide the float covered a distance of about three-fourths of a mile up stream in about 3½ hours. The actual distance traversed by the float was much greater than this because of its going up Scotts Creek, and grounding, and the time lost in the slack water over the mud flat before it finally grounded would account for an appreciable part of the total time consumed.

2. A float was turned adrift in the Elizabeth River Channel, about 100 yards below Lambert Point coal piers, about 1½ hours before the beginning of the flood tide, at 10.35 o'clock on the morning of November 27, 1914, allowed to drift through the turn of the tide, and was picked up about 4½ hours afterwards. A sewer, known as the Pocahontas Avenue sewer, empties into Elizabeth River about 1,000 feet from the shore, near the outer end of the downstream side of the Lambert Point Piers. From observations taken at 30-minute intervals the float did not progress very far on this tide, as the force of the tide had spent itself and the beginning of the flood tide caused a period of slack water lasting almost an hour. After the slack period the float was swept up the river. Throughout the period of observation the float maintained a course through the deep water of the channel and exhibited only a slight tendency to drift toward the east shore near the end of the run. Under the influence of the last of the ebb tide, the float drifted downstream about 350 yards in 1½ hours, and about 1½ miles upstream under the influence of flood tide, in about 1½ hours.

The following observations, made by the Coast and Geodetic Survey, also show approximately the current flow in the river:

Velocity of tides in Elizabeth River.

Location.	Velocity of tide.		Date.	Period of observation.
	Flood.	Ebb.		
	Knots.	*Knots.*		*Days.*
Off Clyde Line Dock	0.93	1.08	Mar. 20 to 30, 1911	11
Channel off mouth of Western Branch	.80	.90	May 25, 26, 1876	1
Channel off Red Nun Buoy 34	.80	1.00	May 24, 27, 1876	1
Channel off junction of Southern and Eastern Branches.	.50	.70	May 16, 29, 1876	1½
Channel off Eastern Branch, off Old Dominion Dock.	.60	.60	May 20, 21, 1876	1½
Eastern Branch, in channel off grain elevator	.60	.40	May 15, 29, 1876	1
Southern Branch, in channel off United States Navy Yard.	.80	.80	May 20, 21, 1876	1½

Average flood velocity, .72; ebb velocity, .754, or an excess of downward or ebb movement of .034 knot, or about .425 nautical miles per day.

So far as may be determined from these observations and the laboratory results obtained, none of the sewage from these communities, except that from the Pocahontas outfall at Lambert Point, reaches the channel of Hampton Roads from the outfalls on one ebb tide, consequently the flood tide carries back into the estuaries and up the main channel almost all of the sewage, except such as by gradual diffusion reaches the waters of Hampton Roads. Thus the harbor is, generally speaking, a collecting basin and disposal plant. It is probable that the lower limit for this condition is above a line from the mouth of Tanners Creek to Craney Island, or even higher. The sewage thus confined is carried back and forth, either settling during periods of slack water or remaining in solution or suspension until biological and chemical factors cause its disintegration and oxidation. The amount of stream flow is small compared with the total content of the river bed, and the currents are greatly influenced by the direction and force of the wind, locally and in Chesapeake Bay. The whole community is only a few feet above tide level, and not infrequently the water front of Norfolk is partially submerged by extraordinary tides, caused by northeast gales.

It was decided to defer determinations of oxygen content until warm weather. Around the wharves and water front, however, the odor and gas formation show evidence of anaërobic action and deficiency of free oxygen; such evidence was not seen lower down the river, nor above the upper bridge, across the Eastern Branch.

SHELLFISH BEDS.

Southern branch.—Oysters were formerly both grown and floated above the navy yard, but this practice has been abandoned. The water on ebb tide is highly colored by the waters from the Dismal

Swamp Canal. Neither of two samples of oysters taken therefrom scored over 14, but of three samples of water one showed *B. coli* in 0.1 c. c., and two in 1 c. c. quantities. A large amount of sewage enters this branch form the navy yard and training station and from the ships at the yard. The taking of oysters therefrom should not be permitted.

Eastern branch.—The oyster beds of this branch extend from above the upper or Virginian Railroad bridge to near the head of the branch and into two tributaries, Indian Creek and Broad Creek. Seventeen samples of oysters and 29 samples of water over the beds were taken September 28 and October 23, 1914, with the following results:

Samples of water and oysters.

Number of samples taken from Eastern Branch of Elizabeth River which scored—

Over 50	2	4	1
50	2	3	0
41	4	2	0
32	2	1	0
23	3	0	0
14	1		
5	2	Total	17

Number of samples of water which showed *B. coli* present in the following quantities:

10 c. c.	28, or 96 per cent.
1 c. c.	27, or 93 per cent.
0.1 c. c.	20, or 69 per cent.
0.01 c. c.	7, or 24 per cent.
0.001 c. c.	0, or 0 per cent.

Thus of 29 samples of water, only 1 showed *B. coli* absent in 10 c. c., and 1 present in that quantity but absent in 1 c. c.

Of two samples each of oysters and water taken from a bed 300 yards above the bridge, one scored 320 and the second 230; while both samples of water showed *B. coli* in 0.1 c. c. This area is within the flood tidal radius of large sewers, and oysters therefrom are unfit for human consumption, raw or cooked. Prosecution by Federal authorities followed the interstate shipment of oysters therefrom. A score of 50 was shown by oysters from a bed 200 yards off Kemp's house, near the mouth of Indian Creek, just above the former beds, and the lessee was notified by the State inspector to move his oysters. Another sample, taken between this locality and Broad Creek, gave a score of 50. Thus 23.5 per cent of the oysters scored 50 or more, and of the samples taken in Eastern Branch proper, between Broad Creek and the bridge, 100 per cent scored 41 or more, and all but one scored 50 or more. In two samples of water *B. coli* were present in 1 c. c., and in all others in 0.1 c. c. to 0.01 c. c. The evidence points strongly to this pollution being of sewage origin, and it is manifest that such waters should no longer be used as a direct source of oysters for food.

Of four samples taken in the Branch above Broad Creek two scored 41 each, one 32, and one 4, while in the water samples *B. coli* was present in 0.1 c. c. in three samples, and in 10 c. c. but not in 1 c. c., in one sample. Of the seven samples taken in Indian Creek, an estuary extending southward for about 1½ miles, the one already alluded to, from near the mouth, scored 50; two scored 41 each, one scored 14, and two scored 5. A great many oysters are planted in Indian Creek, and there is some doubt as to whether the pollution is from the sewage of Norfolk or from agricultural and stock farm wash. The sewage probably reaches at least as far as the bend below the bridge.

Broad Creek is a long estuary reaching northward from above and opposite Indian Creek toward the surface ponds from which the water supply of Norfolk is derived. There appeared to be few oysters in Broad Creek, and of the two samples taken near the entrance and above the Virginia Beach and Cape Henry bridge one scored 32, and one scored 23; the water sample with the former showed *B. coli* present in 1 c. c.; and with the latter, absent in 1 c. c.

A study of the results obtained by bacteriological examinations and sanitary survey gives convincing evidence that Eastern Branch, from its mouth to at least the entrance to Broad Creek, and Indian Creek to at least the bridge or curve below are unsafe as sources of oysters for consumption raw. The flood current is so sluggish that there is doubt that the pollution reaches the prong above Broad Creek, or Indian Creek above the narrow curve. Results obtained from samples of water indicate considerable pollution everywhere at present; the size of the city, and consequently the amount of pollution, are increasing, and it will be advisable soon to abandon the whole area as a source of oysters to be consumed direct from the beds. The area seems to be peculiarly valuable for the growth of oysters, and there seems to be no objection to the growing of oysters here for transplantation, under supervision, to nonpolluted beds.

Western Branch.—There are a few scattered oysters on the north side of the channel near the mouth of the branch; two samples taken from deep water there scored respectively 50 and 5, with corresponding samples of water showing *B. coli* present and absent in 1 c. c. The first beds of consequence lie on the south side of the channel, about 1½ miles above the entrance. Four samples of oysters taken in this area scored, beginning with the sample from below, 4, 5, 2, and 0, with *B. coli* in 1 c. c. quantities in two out of three samples of water. There are extensive beds above the upper bridge about 2 miles from the mouth of the branch, in which area 10 samples of oysters and 9 samples of water were taken. Of the oysters, three samples scored 0; two scored 1; three scored 2 each; and the remaining two scored 4 and 5 respectively. Of the nine samples of water from over the beds, three were negative for *B. coli* in 1 c. c., the largest amount used for them; five were positive for this organism in 1 c. c., and one was positive in 10 c. c., but not in 1 c. c. The total bacterial count at 20° was 100,000, or more, for all except one of the samples of oysters, which count was 4,400. A higher *B. coli* content was expected from oysters in this area, as large piles of manure were seen upon the nearby fields and the land around the branch is one of the most intensively cultivated areas in this great trucking section. It is probable that little if any sewage from Norfolk reaches the upper beds of Western Branch until after a considerable interval, in which high dilution has occurred; but it is certain that the lower beds are not safe as a direct source of supply for oysters to be eaten raw.

"Paradise Creek" and "The Hague" are small coves or estuaries which discharge into the Elizabeth River from the east, separating the older portion of Norfolk from Atlantic City, a suburb on the shore, and from Ghent, a fashionable residential section. Paradise Creek runs for a mile or more through the city and is virtually an open sewer, in fact both estuaries receive a large amount of direct sewage.

A few large fat "cove" oysters grow in this area, and tongers were seen tonging them. The sale of such oysters is dangerous, and it would seem that ordinary police measures could stop the taking of shellfish from this area. A small natural oyster area, known locally as Joshuas Rock, exists on the east side of Elizabeth River below Fort Norfolk; no bacteriological determinations are needed to give evidence as to the unfitness of such oysters for food. The area west of the main channel of Elizabeth River and opposite Lambert Point piers, from Lovetts Point to Craney Island, was formerly an extensive and valuable oyster bed. A large copper smelter on Lovetts Point has been the subject of much litigation, planters having sued for damage to their oysters.

At the time when samples were taken in this area (October 1, 1914) there were few oysters on the beds. The oysters collected were somewhat greenish, in the bodies as well as gills, and one or two had an ulcerous condition: unfortunately these samples were destroyed before laboratory study could be made as to the nature of the trouble. Of the eight samples each of oysters and water examined, one scored 32; two, 14 each; two scored 3; one scored 1; and two scored 0. Fifty per cent of the water samples gave *B. coli* present in 1 c. c. The total bacterial counts here were quite large. The dilution in this area is considerable; but undoubtedly some sewage from Norfolk and Portsmouth reaches these waters within one ebb tide, and they should not be used as a source of oysters consumed raw. Determinations made in the Hygienic Laboratory showed the copper content not to exceed the normal proportion in average oysters from other sources.

The area east of the channel of the Elizabeth River, from Lambert Point coal piers to the mouth of Tanners Creek, constitutes a very prolific oyster growing area, most of which is public grounds, some private beds being located near the mouth of the creek. Into the section near the pier head the sewage is discharged from the large Pocahontas Avenue sewer, previously described. Of 19 samples of oysters and 18 samples of water taken with them from this area, 1 scored 140, with the water showing *B. coli* in 1 c. c.; 1 scored 41, with *B. coli* in 1 c. c. of water; 4 scored 32, with one sample of water showing *B. coli* absent in 10 c. c., in 2 samples present in 10 c. c., and in 1 sample present in 1 c. c. Two samples of oysters scored 23, with water showing *B. coli* in 1 c. c. The remaining samples gave scores of from 14 to 3. Of 21 samples of water, 1, or 5 per cent, showed abscence of *B. coli* in 10 c. c.; 19 samples, or 95 per cent showed *B. coli* present in 10 c. c.; 10 samples, or about 50 per cent, gave *B. coli* in 1 c. c.; and 3 samples, or 14 per cent, gave *B. coli* absent in 1 c. c., no larger quantity of these 3 samples having been used.

These results were rather surprising, as a heavier pollution in this area was expected. It will be seen upon inspection of the map that all except one of the oyster samples which scored 32 or more were near the edge of the main channel, the exception having been taken at the entrance to Tanners Creek. The samples taken between the shore and the sewer outfall all show a low score. It is possible that the results may have been due partly to the location of the sewer outfall near the channel and pier heads; during ebb tides the inner beds are in the lee of the filled land and pier heads, hence the water is almost tideless except for a drainage directly toward the main channel at the pier head. On flood tide the effluent is pushed shoreward and, eventually, out along the bulk-head toward the channel. The group of samples taken on the rock just south of the pier heads seem to point to this conclusion, though part of the pollution here doubtless comes down the channel from Norfolk. Dilution undoubtedly affects results in this region; the river between Lambert and Lovetts Points is at least 1 mile wide, with a broad, deep, channel, and gradually broadens to over 1½ miles at Craney Island, where the enormous volume of water from the James River joins that from the Elizabeth River.

The State of Virginia several years ago forbade the taking of oysters for sale as food from this area above a line from Craney Island Light to a buoy off the mouth of Tanners Creek; but, so far as observed, there had been no enforcement of the law, and tongers were observed daily all over the forbidden area, including the highly-polluted section near the pier heads. Despite the dilution, this area is dangerous, and shellfish should be taken only under such constant direct supervision as will insure transplantation, for cleansing, in unpolluted waters.[1]

Tanners Creek, as previously described, discharges into Elizabeth River at its mouth, 1½ miles north of Lambert Point.

The north, or Norfolk, shore is being rapidly populated and considerable sewage is discharged on that side; the amount of dilution, however, is very great and of thirteen samples of oysters taken therein only three gave a score as high as 32; of these one was taken just inside the entrance, one down the southern prong near a public park and sewer outfall, and one inside the entrance in the southern prong. One sample of oysters scored 14, and the nine remaining samples less than 5 each. Two samples of water from the vicinity of the bridge near the junction of the prongs showed *B. coli* in 0.01 c. c.; eight in 1 c. c.; two, near the mouth, in 10 c. c., but not in 1 c. c.; and one, from near the mouth, gave *B. coli* absent in 10 c. c. Both samples of water taken from the bed off the Country Club showed *B. coli* in 1 c. c., but the oysters scored only 3 and 4.

There is a constantly increasing danger in oysters from the upper end of the creek, as a result of increasing pollution; but the lower beds, except in the immediate vicinity of outfalls, are believed, at least at present, to be safe and suitable for oyster beds.

Taking Elizabeth River and its branches as a whole the results may be summarized as follows:

Of 101 samples of oysters, the following number and per cent gave scores of:

Score:	Number.
Over 50	3
50	4
41	7
32	10
23	5
14	8
5	13
4	14
3	8
2	7
1	14
0	8

or, 7 per cent scored 50 or more, 14 per cent, 41 or more; 24 per cent, 32 or more; and 76 per cent, less than 32.

Of 131 samples of water, 110, or 84 per cent, gave *B. coli* in 10 c. c.; 83, or 63 per cent, in 1 c. c.; 31, or 23.5 per cent, in 0.1 c. c.; and nine, or nearly 7 per cent, in 0.01 dilutions. Eleven samples not worked in 10 c. c. quantities showed *B. coli* absent in 1 c. c., and one not worked in 1 c. c. absent in 0.1 c. c.

It should be noted further that these include the comparatively unpolluted waters of the Craney Island Flats and Broad Rock, which are not properly within the river. Even if there be excluded samples from the above area and the 12 samples which were not worked in 10 c. c. because of the apparently heavy pollution, and which were negative in the lowest dilution used, of the 104 samples from all other parts of the Elizabeth River and its branches, 98, or 92 per cent, were positive for *B. coli* in 10 c. c.; 78, or 75 per cent, were positive in 1 c. c.; 31, or 30 per cent, were positive in 0.1 c. c.; and nine, or 9 per cent, in 0.01 c. c.; moreover, had more samples been worked in 0.01 dilution, it is probable that a larger per cent would have been positive in that small quantity.

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[1] Since the examinations by the Service the present State commissioner of shellfish has been energetic in preventing the taking of oysters from these and other areas reported polluted.

SUMMARY.

It is obvious from a topographical and laboratory study that the waters of the Elizabeth River and its branches, down to the entrance, are polluted with sewage, and that the harbor in the immediate vicinity of the water front is highly polluted.

From a liberal standpoint, based upon probable sewage pollution it may be stated that all the waters of Elizabeth River above a line drawn from the upper side of Tanners Creek to Craney Island Light, all of Eastern Branch up to Broad Creek, Indian Creek to the curve below the bridge, Western Branch to at least 1½ miles above its entrance, Tanners Creek near the shore line and sewer outfalls, as well as Scotts, Paradise, and the Hague Creeks, comprise an area from which oysters should not be taken for consumption, unless previously planted in unpolluted waters until cleansed; there should also be included the Broad Rock beds within a few hundred yards of the channel.

From a more stringent viewpoint, based upon possible infectious pollution, even the previously excepted areas must be included, except perhaps the lower end of Tanners Creek, and possibly Western Branch above, 2 miles from the entrance.

Norfolk is one of the great oyster shucking and shipping centers of the world; oysters from beds all over the Chesapeake Bay are handled there. From a commercial standpoint, the oysters actually taken from the Elizabeth River area are not an important factor. So long, however, as the oysters from these dangerous areas are allowed to be sold by ignorant or unscrupulous men, suspicion will rest upon all shipments from the port.

According to the annual report of the commissioner of fisheries of Virginia, during the year ended October, 1913, there were over 1,000,000 bushels of shucked oysters alone shipped from Norfolk, this port handling about one-fifth of the annual output of Virginia. He reports that the oysters came from the seaside, and from the James, York, Rappahannock, Potomac, and other waters.

There seems to have been in the past a lack of concerted action between the municipal and State health authorities, the State food inspection authorities and the State fisheries commission. The prompt and energetic action now being taken by the last two mentioned officials removes the danger.

The taking of oysters from polluted areas should be prohibited except under constant supervision of some competent authority, and under such conditions as will ensure transplantation. Such supervision, to be effective, must include the actual physical presence of competent authority at all times; the only other alternative would appear to be the destruction of the oyster beds.

CONCLUSIONS.

The following conclusions apply to Hampton Roads and vicinity:

1. State authorities were advised to forbid the taking of oysters from certain sections of Mill Creek which showed danger of infectious pollution.

2. As a result of the inspection of the National Soldiers' Home for Disabled Volunteers, located to the west of Phoebus at the entrance to Hampton Creek, changes in construction were suggested by Sanitary Engineer Hommon of the Public Health Service. It is believed that satisfactory results will be obtained upon completion of these changes. A sewage disinfection plant was also installed at Hampton Institute.

3. Evidences of gross pollution were seen at various places in Hampton Creek. Oyster beds occupy nearly all of the bottom from Queen Street Bridge to the head of the Creek. There was no doubt that oysters from this source were unfit for human consumption, unless transplanted to waters suitable for self-purification. The State authorities were so informed, and all of the beds in the creek were condemned.

4. The Salters Creek outlet is at present a serious menace to the continued use of the upper oyster beds of the Hampton Flats, and this menace is increasing. If the present method of discharging raw sewage from this source be continued, the condemnation of a large area of oyster beds will inevitably follow.

5. In brief, it may be said that all the waters of the Elizabeth River from the upper side of Tanners Creek to Craney Island Light, all of the Eastern Branch up to Broad Creek, Indian Creek to the curve below the bridge, Western Branch to at least 1½ miles above its entrance, Tanners Creek near the shore line and sewer outfalls, as well as Scotts, Paradise, and Hague Creeks, comprise an area from which oysters should not be taken for consumption, unless previously planted in unpolluted waters until cleansed. Transplanting can be carried on safely only under supervision consisting in the actual presence of competent authoritiy at all times. The amount of pollution is increasing, and it will be advisable soon to abandon the whole area as a source of oysters to be consumed direct from the beds.

6. All shellfish areas in Hampton Roads and vicinity not specifically treated in the above conclusions may be considered safe for the production of shellfish, but the study of the area should be continued.

LYNNHAVEN BAY.[1]

Perhaps the most widely known variety of oysters in the Chesapeake Bay region derives its name from this peculiar inlet. These oysters are connected in the public mind with Norfolk, as they are shipped through that port and the area is therefore discussed at this place. It is important to bear in mind, however, that the waters of the two localities are not connected, save that the ultimate source of sea water for both is the Atlantic through Chesapeake Bay.

Cape Henry is the southern point at the entrance from the Atlantic Ocean into Chesapeake Bay. From Cape Henry the shore gradually recedes in a gentle curve southward for 5 or 6 miles, thence northward to Willoughby Spit, which marks the southern point of the entrance to Hampton Roads. The main channel from the ocean into the bay hugs this southern shore for several miles. The area of Chesapeake Bay south of the channel, partly inclosed by this arc, is known as Lynnhaven Roads and is a well-known anchorage for large vessels, such as battleships.

The shore line around Cape Henry is marked by sand dunes, or hills, which by reason of their boldness and unusual height (80 feet) show conspicuously. Inside this range the land is lower and there are many ponds, from some of which the water supply of Norfolk is in part obtained. Some of these were formerly connected with the bay by narrow inlets. About 4 miles westward of Cape Henry, a narrow and shallow inlet, Lynnhaven Inlet, leads from Lynnhaven Roads into Lynnhaven Bay, a shallow body of water which extends in a southeasterly direction for about 3 miles, gradually narrowing from its original width of about half a mile. A short distance from the entrance another prong, the upper end of which is known as Old Donation Creek, extends 3 miles southwesterly. Immediately inside the inlet there is a narrow channel, about 100 feet wide, which extends eastwardly immediately behind the shore dunes to end in an expansion known as Broad Bay, and this again is connected with a two-pronged body of water about half a mile wide and 2 miles long, known as Linkhorn Bay. A large part of the bottom is mud; all of the water is 5 feet or less in depth, and much of the area is bare at low tide.

The salinity of the water in different sections of this area varied from 1.0180 to 1.0165, and the temperature varied about 1° C.; it is thought these variations may be due to springs similar to those which supply the ponds to the westward. The drainage area is small and rather sparsely settled, and a part is cultivated. There are a few privies near the shore line. So far as could be ascertained the only direct pollution is from a club or pavilion and residences on the ocean above Virginia Beach, the sewage from this source being discharged untreated into an upper prong of Linkhorn Bay.

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[1] See map No. 16 of Norfolk and vicinity.

Nearly every available square yard of the area is used for oyster culture, as the oysters from Lynnhaven always command very high prices. It is stated that the method adopted by the best planters is to grow oysters in Broad and Linkhorn Bays, and then place them on layings in Lynnhaven Bay or Old Donation Creek to fatten and receive the peculiar flavor of the locality. Oysters are now, in some instances at least, brought from other localities for that purpose. No dredges are used, the oysters being carefully handled with small nippers or picked by hand.

At the time samples were collected a heavy northeast gale with rain prevailed. Eleven samples of oysters and 10 of water were collected, the majority of them from points near dwellings on shore. Of the oyster samples, 1 scored 41, 2 scored 32, 4 scored 23, 2 scored 14, and 2 scored 5 each. The total counts of shell liquor at 20° were rather high, varying from 50,000 to 800,000. Two samples of water showed *B. coli* absent in 10 c. c., 2 present in 10 c. c., but not in 1 c. c., and 6 present in 1 c. c. The 37° bacterial counts of the water were all under 50, except one from the entrance to Broad Bay, which was 165. The oysters which scored 41 came from the same locality; these samples were taken a few feet from shore.

The amount of sewage which enters the Lynnhaven waters is very small, the dilution by water, practically from the ocean, is enormous and care seems to be taken by the planters to void pollution. It was stated that oystermen are not allowed to void their discharges overboard but compelled to go ashore. While it is true that practically no sewage is discharged into Linkhorn Bay during the oyster season and little at any time, and while it is stated that this area is used for seed purposes only, no condition which presents even the possibility of pollution should be allowed to exist as a menace to such a valuable source of wealth. The proper authorities, either local or State, should prevent any pollution from entering these waters. The oysters from Lynnhaven are now safe and free from infectious pollution.

GENERAL SUMMARY.

The objects of this investigation have been to find out if there were in Chesapeake Bay or its tributaries polluted areas from which shellfish were being taken; and if so, definitely to locate them and to inform the local, State, and United States authorities of the conditions. It has also been desired to point out, if practicable, the remedy. The conditions found have in general been good, and the results so far obtained are valuable and encouraging.

In Chincoteague Island, from which place alone between 300,000 and 500,000 bushels of oysters and several million clams are shipped annually all over the country, a condition was found which was particularly dangerous and must eventually have resulted in disaster. These conditions were remedied, and if the State authorities continue the inspection work, improvement in the health of the community itself will follow.

In Hampton Creek conditions existed which were intolerable; cases of illness have doubtless been caused for years by eating oysters from the creek, and the shipment of a few oysters from the 57 acres of beds in the creek imperiled the whole industry of the section. In Mill Creek similar conditions existed and shipments were being made freely from both creeks, in spite of a condemnation of the area several years ago by State authority. As a result of this investigation, the Federal and State Governments have taken joint and effective action to prevent such shipments and the communities have taken steps both there and in Chincoteague toward the installation of sewage-disposal systems. It is believed that oysters now shipped from this section are safe.

In Annapolis Harbor, and especially in Spa Creek, conditions were found similar to those in Hampton. Officers of this service detected shipments of oysters from Spa Creek and it was reported to proper authorities. In Norfolk Harbor certain beds used were found dangerously polluted and the State and Federal authorities notified.

Eleven hundred and sixty-six samples of shellfish were collected from the waters investigated, including 428 samples in the Potomac River, of which 34, or about 3 per cent, were found to contain a sufficient number of *B. coli* to give a score of 50 or more. At present 50 is generally considered the limit of safety from the bacteriological standpoint. (See table, end of report.)

While the figures are correct, however, the inference naturally drawn from this statement alone would convey a very erroneous impression as to the sanitary conditions in the area. Manifestly, in an investigation of this kind it would have been misdirected energy to have spent time and money in collecting as many samples from those beds on the ocean side and in the open waters of the bay which observation and experience showed free from danger as from the areas which a superficial survey showed liable to infectious pollution. It would have been useless, for example, to have studied the 65,000 acres of oyster beds in the open waters of Tangier Sound as intensively as the small areas in Elizabeth River or Severn River, Maryland. An opinion, therefore, based upon the percentage of samples found polluted is not justified.

A more nearly correct idea of the conditions is conveyed by the statement that of the 400,000 or 500,000 acres of shellfish-producing areas in the waters of Maryland and Virginia, about 2,000 to 2,500 acres, or one-half of 1 per cent have been found polluted. But it is not to be understood that the whole, even of this polluted area, is used for the production of oysters; a large portion has been voluntarily abandoned by lessees; the enforcement of laws prevents the taking or shipment from other sections, and there remain comparatively small dangerously polluted sections from which shellfish are taken. The problem, therefore, is to prevent further pollution, and to insure freedom from pollution of all oysters taken from the waters of Maryland and Virginia by preventing the taking of oysters from these small and comparatively unimportant beds.

By reason of the interstate character of this industry and its bearing on the spread of infectious diseases from one State to another, it is an essential function of the Public Health Service to determine dangerously polluted areas, and authority should be granted to control such pollutions so far as relates to interstate commerce.

It is the duty of State and local health authorities, on the other hand, to protect their own citizens by also preventing pollution, or where this is impractical, by stopping the collection of shellfish from infected areas. It is the function of these authorities furthermore to prevent the infection of shellfish after they are taken by compelling sanitary conditions in shucking houses, and especially in retail establishments and restaurants. The problem of control from oystermen to consumers, therefore, is one requiring cooperation on the part of local, Federal, and State authorities.

The principal problem is how to prevent absolutely the taking of oysters from beds which have been condemned. That the mere forbidding or prohibition by law of such a practice does not insure prevention may be illustrated by the Lambert Point and Spa Creek incidents. Official supervision must be maintained over such beds.

There is no reason from a sanitary point of view why oysters may not be grown in polluted areas if they are afterwards transplanted to nonpolluted water and allowed to remain until free from pollution. Unless accompanied by actual constant supervision, however, permission for such transplantation is liable to abuse, in fact, is certain to be abused. It has been suggested that such transplantation might be allowed during the summer or closed season only, and the suggestion is a good one; the only alternatives are the prevention of the gathering of the oysters as above mentioned, or the destruction of the beds by State authority with sale of the oysters for transplantation in case of public grounds.

Although the protection of the public health is the most important ground for the control of the oyster industry, nevertheless, from an economic standpoint, the States mentioned owe to their citizens the duty of protecting from pollution valuable beds in danger of being rendered unnecessarily valueless.

The State of Maryland has laws authorizing the State department of health to direct and regulate the construction of sewage disposal plants where necessary for the prevention of pollution. Although more vitally affected than any other State by injury to her shellfish industry, and despite the millions of dollars brought into the State by this industry, Virginia has no laws regulating the pollution of her water. The necessity of such legislation has previously been urged by the writer. Unless it is secured, the destruction of many shellfish beds in Virginia will be inevitable, and such legislation is again recommended.

Under present conditions, the oysters of Chesapeake Bay and its tributaries are a safe food as a whole, and it should be the aim of Maryland and Virginia to conserve and increase this great source of wealth of their people.

APPENDIX.

Table showing results of examinations of individual samples of shellfish and waters of Chesapeake Bay.

Date.	Hour.	Number.	Location at which sample was taken.	Depth.	Tide.	Turbidity.	Wind.	Weather.	Salinometer reading.	Temperature.	Colonies per cubic centimeter.		Smallest quantity of water from over bed in which *B. coli* was present.	Score based on *B. coli* in shell liquor.
											From water over bed in agar for 24 hours, at 37° C.	From shell liquor in agar for 72 hours, at 20° C.		
			Chincoteague Island:	*Feet.*					*Salinometer.*	°*C.*			*C. c.*	
1914. Oct. 21	8.30 a. m.	1	East side near island, L. T. Wilkenson's bed.	13	Flood.	0	NW.	Clear	1.0245	17.8	98	80,000	−10	1
	9.45	2	East side near inlet in front L. T. Wilkinson's.	12	...do...	0	NW.	...do...	1.0235	17.8		31,000		3
	1.10 p. m.	3	Opposite inlet below island.	10	Ebb...	50	S.	...do...	1.0250	19.0	97	14,500	−10	0
	1.15	4	Opposite inlet, hammocks bearing south, west side channel bed of O. L. Wimber.	12	...do...		S.	...do...	1.0250	19.0		200,000		2
	1.25	5	Opposite inlet on west side channel opposite creek mouth, bed of C. L. Jester.	12	...do...		S.	...do...	1.0150	20.5		250,000		2
	2.45	6	East side of channel off lower end of town opposite Jas. Daisy's house, Andrews' bed.	9	...do...	5	N.	...do...	1.0220	18.5	19	150,000	+10	3
	2.25	7	Bay 300 yards west of Killick lighthouse.	4	...do...	5	NE.	...do...	1.0220	19.5	26	6,200	−10	0
20	1.30	1	At bridge across gut, at south end of island.	1	...do...	5	E.				3,000		+10	
21	10.15 a. m.	2	S. R. Dan's, outlet from well to float for drinking.			Light color.					4,000		+ 1	

	10.30	3	Thomas Savage's, outlet from well (water had been standing in tank 3 to 4 days).	....	....	....	....	....	....	....	60	....	−10	....
	10.40	4	K. Jester's, outlet from well at tap outlet.	....	....	....	....	....	....	....	5,000	....	+10	....
	10.45	5	Disboro's well at pump outlet (type also for D. J. Whealton).	....	....	....	....	....	....	....	580	....	+ 1	....
	11.00	6	Seawater from Rowley's clam floats.	....	....	....	....	....	....	....	250	....	+ 1	....
	11.15	7	Whealton Oyster Co.'s shucking house, water from tap.	....	High..	....	....	....	....	....	8,000	....	+ 1	....
1915. Jan. 23	7.00 a. m.	15	Float of W. C. Bunting.	....	....	0	W.	Cloudy..	....	4.0	230	31,000	+ 1	[2]1
	....	16	Whealton Oyster Co., oysters in box 1, 48 hours.	....	....	....	....	...do.....	....	4.0	19	58,000	−10	1
	....	17	Jas. Rowley, clams from outer float, river water.	....	....	....	W.	...do.....	....	4.0	17	27,000	−10	50
	....	18	Whealton Oyster Co., box 2, in float 12 hours.	....	....	....	....	....	....	4.0	8	21,000	+10	3
	....	19	Float Wm. Harrison, near drain from Dr. Smith's house.	....	....	....	....	....	....	4.0	54	33,000	+ .1	2
	....	20	Float of Thos. Savage.	....	....	....	....	....	....	4.0	51	110,000	+10	32
	....	21	Float of J. K. Jester..	....	....	....	....	....	....	4.0	17	14,000	+10	[2]32
	....	22	Float of E. N. Watson, 24 hours in float.	....	....	....	....	....	....	4.0	18	29,000	+10	[2]1
	....	23	Float of S. R. Davis, 12 hours in float.	....	....	....	....	....	....	4.0	80	130,000	−10	[2]23
	....	24	Float of J. B. Savage, 48 hours in float.	....	....	....	....	....	....	4.0	56	41,000	+10	3
Feb. 13	....	4	Float of J. B. Savage, oysters 2 days in float.	....	....	....	....	....	1.0090	....	190	5,200	+ 1	2
	....	5	Float of S. R. Davis, oysters 2 days in float.	....	....	....	....	....	....	....	63	500	+10	0
	....	6	Float of E. N. Watson, oysters 3 days in float.	....	....	....	....	....	....	....	38	2,800	−10	0

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[1] Clams.

[2] Examined 72 hours after taking, owing to grounding of *Bratton*. Kept cold and in refrigerator.

Table showing results of examinations of individual samples of shellfish and waters of Chesapeake Bay—Continued.

Date.	Hour.	Number.	Location at which sample was taken.	Depth.	Tide.	Turbidity.	Wind.	Weather.	Salinometer reading.	Temperature.	Colonies per cubic centimeter.		Smallest quantity of water from over bed in which *B. coli* was present.	Score based on *B. coli* in shell liquor.
											From water over bed in agar for 24 hours, at 37° C.	From shell liquor in agar for 72 hours, at 20° C.		
1915.			Chincoteague Island—Con.	*Feet.*					*Salinometer.*	°*C.*			*C. c.*	
Feb. 13		7	Float of J. K. Jester, oysters 2 days in float.								135	5,500	+10	0
		8	Float of Thomas Savage, oysters 2 days in float.								1,000	1,100	+ 1	0
		9	From Thos. Savage, gathered previous day, had not been floated.									300		0
		10	Float of Wm. Harrison, oysters 3 days in float.								34	2,600	+10	1
		11	Float box 2, Whealton Oyster Co.								35	2,000	−10	0
		12	Clams from Jas. Rowley (not in fresh water).								30	800	+10	1
		13	Whealton Oyster Co., 3 days in float.								1,000	9,000	+10	1
2		14	Wm. Bunting, 2 days in float.								110	18,300	+ 1	10
			Oyster, Northampton County, Va.:											
Jan. 26		25	House of T. K. Hale, said to have come from New Inlet below Cobbs Island.									29,000		2
		26	Armstrong Sea Tag Co., come from Chincoteague or New Inlet.									13,000	−10	1
		27	Pump in shucking house of Broadwater & Powell.								20		−10	

	....	29	Folley Creek, Va., Pope Lang's oysters, front of shucking house.	....	....	....	....	....	....	....	2	15,000	−10	0
	....	30	Inlet north of Hog Island, Va., Atlantic Ocean, from house of J. F. Ward, Willis Wharf, Va.	....	....	....	....	....	....	....	1	8,200	−10	0
	....	31	Revels Island, Atlantic Ocean, Va., from house of J. C. Walker, Willis Wharf, Va.	....	....	....	....	....	....	....	2	100,000	−10	[2] 3
	....	32	Machipongo Inlet, 1½ miles from sea, W. W. Ballard, Willis Wharf.	....	....	....	....	....	....	....	1	13,000	−10	0
	....	33	Hog Island Inlet, H. M. Terry's house, Willis Wharf, Va.	....	....	....	....	....	....	....	14	31,000	−10	0
1914.			Old Plantation Creek:											
Oct. 21	11.25 a. m.	L	Middle of creek	3	Flood.	0	NW.	Clear	1.0195	20	11	2,700	−10	2
	11.45	m	Off north shore	4	...do...	0	NW.	...do...	1.0190	20	13	2,500	−10	1
	12.00	n	Bed of Mr. Glaxner	6	Ebb..	0	NW.	...do...	1.0190	19	22	3,900	−10	2
	12.25 p. m.	o	In arm of creek	6	...do..	0	NW.	...do...	1.0190	19.5	10	2,600	+10	0
	12.45	p	South side	3	...do..	0	NW.	...do...	1.0190	19.25	15	1,300	−10	1
	1.05	q	Bed of George Manley	2	...do..	0	NW.	...do...	1.0120	20.5	28	900	−10	1
			Kings Creek:											
	8.45 a. m.	j	Near head of creek	3	Flood.	0	NW.	...do...	1.0200	18	18	14,800	−10	3
	9.00	k	On bar inside mouth of Kings Creek.	2	...do..	0	NW.	...do...	1.0200	18	24	4,500	−10	0
			Cherrystone Creek:											
20	12.30 p. m.	a	In mouth of small creek above Westcotts Point.	6	Ebb..	0	NW.	...do...	....	....	32	19,000	−10	4
	12.45	b	In cove 1,500 yards above "a."	4	...do..	0	NW.	...do...	....	....	20	17,500	+10	14
	1.05	c	Off yellow house, mouth of Old Castle Creek.	4	...do..	0	NW.	...do...	....	....	28	2,000	+ 1	14
	1.25	d	1,000 yards above mouth of Old Castle Creek.	4	...do..	0	NW.	...do...	....	....	92	7,800	+10	14
	1.45	e	Mouth of Eyreville Creek (J. T. Lewis).	4	...do..	0	NW.	...do...	....	....	36	19,500	+10	4
	1.50	f	500 yards above J. T. Lewis, No. 2.	4	...do..	0	NW.	...do...	....	....	64	4,800	+10	5
	2.10	g	Mouth of Eyre Hall Creek, bed of J. R. Bell.	3	...do..	0	NW.	...do...	....	....	26	9,000	−10	4
	2.30	h	Mouth of small creek, 1,000 yards below Eyre Hall Creek.	6	...do..	0	NW.	...do...	....	....	29	2,800	+ 1	3

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[1] Water not changed in float.

[2] Analyzed 48 hours after taking from water.

Table showing results of examinations of individual samples of shellfish and waters of Chesapeake Bay—Continued.

Date.	Hour.	Number.	Location at which sample was taken.	Depth.	Tide.	Turbidity.	Wind.	Weather.	Salinometer reading.	Temperature.	Colonies per cubic centimeter.		Smallest quantity of water from over bed in which *B. coli* was present.	Score based on *B. coli* in shell liquor.
											From water over bed in agar for 24 hours, at 37° C.	From shell liquor in agar for 72 hours, at 20° C.		
				Feet.					*Salinometer.*	*°C.*			*C. c.*	
1914. Oct. 20	2.45 p. m.	1	Cherrystone Creek—Con. On bar above mouth of creek inside Mill Point.	6	Ebb..	0	NW.	Clear....	....	....	....	3,700	....	2
1915. Feb. 17	12.00	15	Crisfield, Md., Harbor: 300 yards above drawbridge, near Shell Islet.	2	....	....	N.	Cloudy..	....	....	....	5,800	....	23
			Little Annemessex—											
	1.00	16	250 yards off fish factory on point.	12	Flood.	0	N.	...do....	1.0155	6.1	20	4,800	+10	2
	2.00	18	At Crisfield Ice Co. dock.	2	...do..	0	N.	...do....	1.0155	6.1	30	(1)	+10	....
	2.05	19	500 yards below dock.	2	...do..	0	N.	...do....	1.0155	6.1	16	(1)	+10	....
	2.08	20	Somers Cove Lighthouse.	2	...do..	0	N.	...do....	1.0155	6.1	20	(1)	+10	....
	2.20	21	Red beacon at entrance.	2	...do..	0	N.	...do....	1.0155	6.1	15	(1)	−10	....
	2.30	22	Rock at entrance, near beacon.	9–12	...do..	0	N.	Fair.....	1.0155	6	16	4,600	−10	0
	3.50	23	Tangier Sound, at black buoy SW. of Deal Island.	12	...do..	0	N.	Cloudy..	1.0160	6	18	500	−10	0
18	10.00 a. m.	24	Nanticoke River..........	2	Ebb..	75	NNE.	Clear....	1.0070	3.8	78	(1)	+10	....
	10.40	25	1 mile below 24........	11	...do..	25	NNE.	...do....	1.0070	3.3	74	2,000	+ 1	0
	11.00	26	Black spar No. 3......	15	...do..	25	NNE.	...do....	1.0070	3.3	72	300	+10	0
	11.30	27	Red buoy, ½ mile below	2	Flood.	25	NNE.	...do....	1.0095	3.3	60	....	−10	....
	11.45	28	Red buoy opposite Roaring Point.	15	...do..	25	NNE.	...do....	1.0100	3.9	58	1,000	−10	0
									Cl. p. p. m.					
1914. Apr. 4	11.30	[2] 20550	Bed 117, Dorchester Co.	11	Ebb ..	30	....	....	7,050	9.6	13	1,270	−10	2
	11.45	[2] 20551	Bed 11, Middle ground, Wicomico.	10	...do...	15	....	....	6,800	9.6	14	330	−10	0
	11.55	[2] 20552	Bed 114, Frog Point...	18	...do...	10	....	....	6,400	9.6	9	2,200	−10	5

			Wicomico River:											
	11.05	[2] 20549	Great Shoals Lighthouse.	6	...do...	8			6,700	9.2	18		−10	
	10.55	[2] 20548	Bed 4, off Evans Point.	12	...do...	5			6,950	9.4	16	3,300	−10	0
	10.25	[2] 20547	Bed, 6, off Halls Point.	11	...do...	5			7,200	9.4	17	45	−10	1
			Manokin River:											
	9.00	[2] 20544	Bed 14, Piney Island Swash.	15	Flood.	2			8,950	8.0	4	1,650	−10	4
	8.45	[2] 20543	Bed 18, Marshy Island	21	...do...	2			9,000	8.2	6	1,050	−10	0
	8.20	[2] 20542	Big Annemessex River, buoy opposite triang 15.	13	...do...	4			9,150	7.8	5		−10	
			Little Annemessex River:											
	3.20 p. m.	[2] 20537	Janes Island Light and Spar 1-A.	15	...do...	2			9,900	7.3	2	15	−10	0
	4.30	[2] 20539	Janes Island light and red beacon.	15	...do...	2			9,900	7.3		70		1
	2.40	[2] 20536	Tangier Sound, Bed 25, Great Rock, Somerset Co.	12	...do...	2			9,700	7.8	10	3,800	−10	5
July 7		g	Fishing Bay opposite Roasting Ear Point.								550	60,000	−10	14
		h	Nanticoke River between red buoy 4 and 6 Roaring Point.								1,600	17,500	+10	4
		i	Monie Bay between Nanticoke Point and Long Point.								4,250	3,750	+10	5
			Tangier Sound:											
		j	Drummond Shoals off Haines Point.								4,500	1,850	−10	2
		k	Red spar No. 8, off Little Island.								5,500	950	−10	5
		l	Red and black buoy entrance to Manokin River.								2,500	2,650	−10	5
		m	Manokin River off St. Pierre Island.								5,500	3,150	−10	5
		n	Big Annemessex River and black beacon at entrance.								3,000	600	−10	5
		o	Big Annemessex River between Jackson Island and Jericho Marsh.								350		−10	2
		p	Kedges Strait black spar No. 1.	10		0	SE.	Clear.			5,500		−10	0
		q	Tangier Sound below bell buoy at entrance Crisfield Harbor.								400		−10	23

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[1] No oysters.

[2] Collected by Department of Agriculture and examined by Hygienic Laboratory, Public Health Service.

Table showing results of examinations of individual samples of shellfish and waters of Chesapeake Bay—Continued.

Date.	Hour.	Number.	Location at which sample was taken.	Depth.	Tide.	Turbidity.	Wind.	Weather.	Salinometer reading.	Temperature.	Colonies per cubic centimeter.		Smallest quantity of water from over bed in which *B. coli* was present.	Score based on *B. coli* in shell liquor.
											From water over bed in agar for 24 hours, at 37° C.	From shell liquor in agar for 72 hours, at 20° C.		
1915.			Wicomico River, Md.:	*Feet.*					*Salinometer.*	°*C.*			*C. c.*	
Jan. 22	7.35 a. m.	6	At Dock White Haven	2	Flood.	0	W.	(²)	1.0050	6.6	86		+10	
	8.10	7	At Truitts wharf	2	...do...	0	W.	(²)	1.0050	6.6	210		+ 1	
	8.20	8	Pecks landing	2	...do...	0	W.	(²)	1.0050	6.0	270		+ 1	
	8.35	9	Upper Ferry	2	Ebb..	0	W.	(²)	1.0050	6.0	230		+ 1	
	8.05	10	Sharps Point	2	...do...	0	W.	(²)	1.0050	6.0	130		+ 1	
	9.05	11	McBrides Reach	2	...do...	0	W.	(²)	1.0050	6.0	600		+ .1	
	9.15	12	Smith & Williams Shipyard.	2	...do...	0	W.	(²)	1.0050	7.2	1,200		+ .01	
	9.20	12½	B. C. & A. Docks, Salisbury, Md.	2	...do...	0	W.	(²)	1.0050	7.2	700		+ .1	
23	7.30	1	.....do	2	Flood.		SW.	(²)		7.0	700		+ .01	
	7.40	2	Below Smith & Williams Shipyards.	2	...do...		SW.	(²)		6.6	800		+ .01	
	7.55	3	Above Shad Point	2	...do...		SW.	(²)		6.6	300		+ .1	
25	8.55	4	Above Upper Ferry	2	...do...		W.	Cloudy..		5.0	690		− 1	
	9.10	2	Pecks Landing	2	...do...		W.	...do...		5.0	340		+ 1	
	9.25	3	Below Quantico	2	...do...		W.	...do...		5.0	420		+ 1	
	9.50	4	Off old brick church	2	...do...		W.	...do...		5.0	560		+ 1	
	10.15	5	Off old brickyard wharf.	2	...do...		W.	...do...		5.0	520		+ 1	
	10.30	6	White Haven	2	...do...		W.	...do...		5.0	300		+ 1	
	10.40	7	Mount Vernon wharf.	2	...do...		W.	...do...	1.0005	5.0	240		− 1	
1914.			Tangier Sound and adjacent waters (Fishing Bay):						Cl. p. p. m.					
Apr. 4	12.40 p. m.	[1] 20555	Bed 103, Dorchester Co., Goose Creek.	6	Ebb..	40			6,900	10.4	20	730	−10	1
	12.30	[1] 20554	Bed 102, Dorchester Co., Evans.	10	...do...	10			7,400	10.2	10	14,500	−10	14
	12.25	[1] 20553	Bed 112, Dorchester Co., Clay Island.	10	...do...	5			7,900	9.8	9	3,800	−10	4
	12.50	[1] 20556	Bed 100, Dorchester Co., Ware sands.	12	...do...	15			7,450	10.0	14	5,300	−10	41
	1.00	[1] 20557	Bed 82, Dorchester Co., Bell Buoy.	10	...do...	5			7,800	9.8	17	820	−10	0

	1.45	[1]20558	Bed 86, Dorchester Co., Mouth of Hooper Straits and Honga River.	18	...do...	0			8,750	8.8	19		−10	
			Honga River:											
July 1		a	Striped buoy at head of channel.								9,000	2,600	−10	5
		b	Black buoy between Wroten Island and village of Fishing Creek.								7,500	8,500	−10	14
		c	Between black buoy and Bentley Point.								13,500	4,000	−10	41
		d	Between Hickory Point and Windmill Point.								3,250	1,250	−10	14
		e	Between Applegarth and Crab Point.								7,500	22,500	+ 1	1
		f	Hoopers Straits red buoy No. 6, between Bishops Head and Shark Fin Shoal Light.								6 000	4,100	−10	32
			Little Choptank River:						Salinometer.					
1915. Jan. 21	9.20 a. m.	1	Bed 58	12	Ebb..	0	NW.	Clear....	1.0150	3.3	16	400	−10	0
	10.05	2	Bed 55	12	...do...	0	NW.	...do.....	1.0150	3.3	54	1,500	−10	0
	10.35	3	Bed 38, in channel off black spar No. 5, off Carsons Point.	20	...do...	0	NW.	...do.....	1.0150	3.3	48	1,100	−10	0
	10.45	4	Bed 41	17	...do...	0	NW.	...do.....	1.0150	3.3	52	2,500	−10	0
	11.00	5	Bed 43, mouth of Fishing Creek.	12	...do...	0	NW.	...do.....	1.0150	3.3	72	2,800	+10	0
			Choptank River:											
			Harris Creek—											
13	2.15 p. m.	18	Bed No. 51, below red spar No. 2.	16	Flood.	0	NW.	Clear....	1.0150	4.4	44	600	+ 1	0
	2.25	19	Bed No. 53, between red spar No. 4 and black spar No. 3.	20	...do..	0	NW.	...do....	1.0150	4.4	14	1,100	+10	1
	2.35	20	Bed No. 65, off Seaths Point.	14	...do..	0	NW.	...do....	1.0150	4.4	95	500	+10	1
	3.15	21	Bed No. 57, off Indian Point.	20	...do..	0	NW.	...do....	1.0150	4.4	52	1,800	+10	1
									Cl. p. p. m.					
1914. Apr. 6	9.25a. m..	[1]20560	Bed 130, Talbot Co., between Goose and Jamaica Points.	30	...do..	5			4,200	9.0	27	2,210	−10	2
	9.30	[1]20561	Bed 5, Talbot Co., Dixon Oyster Bar.	11	...do..	0			4,850	8.2	28	2,300	+10	2

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[1] Collected by Department of Agriculture and examined by Hygienic Laboratory, Public Health Service.

[2] Heavy rain for two days with wind northeast driving water down.

Table showing results of examinations of individual samples of shellfish and waters of Chesapeake Bay—Continued.

Date.	Hour.	Number.	Location at which sample was taken.	Depth.	Tide.	Turbidity.	Wind.	Weather.	Salinometer reading.	Temperature.	Colonies per cubic centimeter.		Smallest quantity of water from over bed in which *B. coli* was present.	Score based on *B. coli* in shell liquor.
											From water over bed in agar for 24 hours, at 37° C.	From shell liquor in agar for 72 hours, at 20° C.		
			Choptank River—Con.	*Feet.*					*Cl. p. p. m.*	°*C.*			*C. c.*	
1914. Apr. 6	9.50 a. m.	[1] 20563	Bed 6, Dorchester Co., Oystershell Point Bar.	10	Flood.	1	....	....	5,100	9.2	23	1,300	−10	2
	10.00	[1] 20564	Bed 127, Talbot Co. off Chancellors Point.	20	...do..	1	....	....	5,250	9.2	18	600	+10	3
	10.15	[1] 20566	Bed 126, Talbot Co., off Chancellors Point.	20	...do..	2	....	....	5,950	9.4	45	4,600	+10	1
	10.20	[1] 20567	Bed 125, Talbot Co., at black spar No. 7A.	8	...do..	1	....	....	5,700	9.4	20	3,060	−10	0
	10.30	[1] 20568	Bed 124, Talbot Co., Bowling Brooke Sand.	54	...do..	5	....	....	6,800	8.7	8	4,600	+10	0
7	9.35	[1] 20584	Bed 70, Talbot Co., Deep Neck, Broad Creek.	8	...do..	2	....	....	7,550	9.4	25,000	31,200	−10	2
	9.20	[1] 20583	Bed 68, Talbot Co., Great Bar, Broad Creek.	16	...do..	2	....	....	7,300	8.8	11	76,000	−10	3
	9.00	[1] 20582	Buoy S-1 off Nelson Island mouth of Broad Creek.	12	...do..	2	....	....	7,100	9.0	42	....	−10	....
	10.30	[1] 20585	One-half mile off Steamboat wharf, Tilghmans Island.	13	...do..	4	....	....	6,750	8.6	50	....	+10	....
									Salinometer.					
1915. Jan. 15	9.50	35	Bed 3, off mouth Cabin Creek.	10	Ebb..	4	NW.	Clear....	1.0105	4.4	45	1,000	−10	0
	10.05	36	Bed 130, off Jamaica Point.	15	...do..	4	NW.	...do....	1.0110	4.4	40	1,400	+ 1	2
	10.15	37	Bed 5, Dorchester Co., below mouth of Warwick River.	8	...do..	4	NW.	...do....	1.0110	4.4	28	900	−10	0
	10.25	38	Bed 129, off Goose Point.	15	...do..	4	NW.	...do....	1.0120	4.4	28	800	−10	0

	10.35	39	Bed 127, above Chancellors Point.	16	...do..	4	NW.	...do....	1.0120	4.4	28	800	−10	1
	10.45	40	Bed 126, off Chancellors Point.	20	...do..	4	NW.	...do....	1.0120	4.4	24	1,800	−10	1
	10.55	41	Bed 125, off Bowling Brooke Creek.	8	...do..	4	NW.	...do....	1.0120	4.4	32	5,900	+10	1
	11.00	42	Bed 8, off Bowling Brooke Creek.	10	...do..	4	NW.	...do....	1.0120	4.4	20	2,800	−10	1
	11.10	43	Bed 123, off Bowling Brooke Creek.	15	...do..	4	NW.	...do....	1.0120	4.4	33	500	+ 1	0
	11.15	44	Bed 9, mouth of Cambridge Creek.	12	...do..	4	NW.	...do....	1.0120	4.4	34	700	−10	4
16	8.25	1	Bed 9, at red spar No. 2, mouth of Cambridge Creek.	12	...do..	4	NE.	...do....	1.0140	3.8	27	3,200	+10	0
	8.50	2	Bed 9, at red spar No. 4, mouth of Jenkins Creek.	36	...do..	4	NE.	...do....	1.0140	3.8	22	6,200	+10	0
	9.10	3	Bed 10, off Le Compts Bay.	15	...do..	4	NE.	...do....	1.0150	3.8	32	1,600	+10	0
	9.25	4	Bed 18, at Red spar buoy No. 4.	16	...do..	4	NE.	...do....	1.0150	3.8	25	2,200	−10	0
	9.45	5	Bed 21, off Todds Point.	16	...do..	4	NE.	...do....	1.0150	3.8	21	900	−10	0
			Broad Creek:											
13	4.15 p. m.	22	Bed 67............	20	Flood.	4	NW.	Clear....	1.0150	4.0	52	900	−10	0
	4.25	23	Bed 69............	18	...do..	4	NW.	...do....	1.0150	4.0	35	1,300	−10	1
	4.55	24	Bed 77............	15	...do..	4	NW.	...do....	1.0150	3.8	58	1,000	+10	2
14	8.25 a. m.	25	Bed 70, off Deep Creek Point.	18	...do..	4	SE.	...do....	1.0150	3.8	59	1,400	+10	0
			Tred Avon River:											
	9.00	26	Bed 91, between Benoni Point and Lighthouse.	20	...do..	4	SE.	...do....	1.0150	3.8	25	4,100	−10	1
	9.15	27	Bed 93, abreast Oxford	20	...do..	4	SE.	...do....	1.0150	3.8	20	1,500	+10	4
	9.25	28	Bed 98, off mouth of Plaindealing Creek.	16	...do..	4	SE.	...do....	1.0150	3.8	84	3,300	+10	1
	9.40	29	Bed 99, on point opposite Goldsborough Creek.	....	...do..	4	SE.	...do....	1.0150	3.8	48	1,100	+10	2
	9.50	30	Bed 101, mouth of Trippe Creek.	12	...do..	4	SE.	...do....	1.0150	3.8	57	2,100	+ 1	2
	10.25	31	Bed 105..............	10	...do..	4	SE.	...do....	1.0150	4.4	54	1,800	−10	1
	10.05	32	Bed 108, below Long Point.	18	...do..	4	SE.	...do....	1.0145	4.4	78	1,300	+ 1	2
	10.25	33	Bed 109, above Long Point below mouth Peach Blossom Creek.	14	...do..	4	SE.	...do....	1.0145	4.4	34	1,900	+10	0

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[1] Collected by Department of Agriculture and examined by Hygienic Laboratory, Public Health Service.

Table showing results of examinations of individual samples of shellfish and waters of Chesapeake Bay—Continued.

Date.	Hour.	Number.	Location at which sample was taken.	Depth.	Tide.	Turbidity.	Wind.	Weather.	Salinometer reading.	Temperature.	Colonies per cubic centimeter.		Smallest quantity of water from over bed in which *B. coli* was present.	Score based on *B. coli* in shell liquor.
											From water over bed in agar for 24 hours, at 37° C.	From shell liquor in agar for 72 hours, at 20° C.		
1914.			Tred Avon River, Maryland:	*Feet.*					Cl. p. p. m.	°*C.*			*C. c.*	
Apr. 6	2.20 p. m.	[1] 20578	Bed 108, Talbot Co., Double Mills.	20	Flood.	1	....	....	7,000	10.6	9	24,000	-10	2
	2.30	[1] 20579	Bed 110, Talbot Co., Watermelon Point.	15	...do..	0	....	....	6,750	10.8	10	52,000	−10	3
	2.00	[1] 20576	Bed 99, Talbot Co., Mares Point.	2	...do..	1	....	....	7,400	10.4	5	2,440	+10	22
	1.40	[1] 20574	Bed 96, Talbot Co., Stewart Island.	7	...do..	1	....	....	7,600	10.0	....	5,400	....	1
	12.20	[1] 20573	Bed 94, Talbot Co., Stone Church.	16	...do..	1	....	....	7,700	8.6	1	2,110	−10	1
	12.10	[1] 20572	Bed 92, Talbot Co., Bachelor Point.	18	...do..	2	....	....	7,550	8.6	15	15,500	−10	5
1915.			Eastern Bay:						Salinometer.					
Jan. 7	10.15 a. m.	35	Bed No. 34 off Long Point.	12	Ebb...	0	SW.	Clear....	1.0155	3.0	7	3,400	−10	50
	10.40	36	Bed No. 54 off Long Point.	18	...do...	0	SW.	...do.....	1.0155	3.0	5	2,300	−10	5
	11.00	37	Bed No. 40 off mouth Shipping Creek.	12	...do...	0	SW.	...do.....	1.0155	3.8	9	1,700	−10	32
	11.15	38	Bed No. 44 inside Turkey Point.	10	...do...	0	SW.	...do.....	1.0155	3.8	10	1,600	+10	4
	11.35	39	Bed No. 48 mouth of Cox Creek.	10	...do...	0	SW.	...do.....	1.0150	....	31	1,700	−10	5
	12.50 p. m.	40	Bed No. 56 Crab Alley Bay.	12	Flood.	0	SW.	...do.....	1.0155	....	7	1,300	+10	3
	1.05	41	Bed No. 57 Crab Alley Bay.	10	...do...	0	SW.	...do.....	1.0155	....	4	700	+10	2
	1.20	42	Bed No. 59 Crab Alley Bay.	16	...do...	0	SW.	...do.....	1.0155	....	24	8,400	+10	32
	1.35	43	Bed No. 60 Crab Alley	....	...do...	0	SW.	...do.....	1.0155	....	7	7,000	−10	5
	1.45	44	Bed No. 62 half way between Parsons Island and Tilghman Point.	20	...do...	0	SW.	...do.....	1.0155	....	5	700	−10	5

			Miles River:										
8	9.50 a. m.	1	Mouth of St. Michaels Harbor.	4	Ebb...	0	SW.	...do.....	1.0150	3.3	29	6,000	+10	2
	10.05	2	Bed No. 12, back of spar No. 11.	12	.. do...	0	SW.	...do.....	1.0150	3.3	7	2,000	−10	0
	10.25	3	Bed No. 14, at Black spar No. 13.	18	...do...	0	SW.	...do.....	1.0150	2.8	11	1,400	−10	1
	10.55	4	Bed No. 21, on bar back of red buoy No. 10.	10	...do...	0	SW.	...do.....	1.0150	2.8	12	1,200	−10	0
	11.15	5	Wye River, bed No. 82, between Bennetts Point and Buff Island.	16	...do...	0	SW.	...do.....	1.0150	2.2	9	300	−10	0
	11.45	6	Mouth of Miles River, bed No. 27, or middle ground at R. & B. buoy.	10	...do...	0	SW.	...do.....	1.0155	2.2	4	1,000	−10	0
	12.05 p. m.	7	Bed No. 76	16	...do...	0	SW.	...do.....	1.0155	2.2	5	700	+10	0
	12.25	8	Bed No. 73	16	...do...	0	SW.	...do.....	1.0155	2.2	7	1,400	−10	0
	12.35	9	Bed No. 65	16	...do...	0	SW.	...do.....	1.0155	2.2	13	700	−10	1
	1.35	10	Bed No. 34 off Claiborne wharf.	12	...do...	0	SW.	...do.....	1.0155	2.2	7	1,400	−10	1
			Miles River:											
1914. Apr. 8	9.45 a. m.	[1] 20591	Buoy 9, off Deepwater Point.	42	Flood.	2	....	....	Cl. p. p.m. 7,400	9.4	545	....	−10	....
	9.15	[1] 20589	Buoy 6	24	...do...	1	....	....	6,650	9.2	67	....	−10	....
	10.00	[1] 20592	Bed 7, mouth of Wye River.	8	...do...	2	....	....	7,000	10.4	139	210,000	+ 1	5
	9.25	[1] 20590	Bed 25, Hambleton Hill.	20	...do...	1	....	....	6,650	9.2	....	180,000	....	14
	8.30	[1] 20587	Bed 32, Talbot Co., off Tilghman Point.	23	...do...	8	....	....	4,900	9.4	540	264,000	−10	5
			Chester River:											
1915. Jan. 2	9.20 a. m.	14	Bed No. 79, off Love Point Light.	12	...do..	0	SE.	Cloudy..	Salinometer. 1.0145	1.1	9	1,500	+10	1
	9.40	15	Bed No. 28, Baybush Point.	12	...do...	0	SE.	...do.....	1.0145	1.1	10	1,200	+10	0
	10.05	16	Bed No. 32, at black spar No. 5.	10	Ebb...	0	SE.	...do.....	1.0135	0.0	7	7,500	+ 1	1
	10.40	17	Bed No. 18, back of red spar No. 7, off Piney Point.	10	...do...	0	SE.	...do.....	1.0135	0.5	8	10,500	−10	0
	11.05	18	Bed No. 40, mouth of Langford Creek.	12	..do...	0	SE.	...do.....	1.0125	0.5	14	900	−10	0
	11.15	19	Bed No. 14, back of Nun buoy No. 8, mouth Corsica River.	8	...do...	0	SE.	...do.....	1.0125	0.5	11	2,100	−10	0
	11.35	20	Bed No. 57, between spars No. 9½ and No. 11, Cliff Point.	10	...do...	0	SE.	...do.....	1.0125	0.8	17	13,500	−10	1

[1] Collected by Department of Agriculture and examined by Hygienic Laboratory, Public Health Service.

Table showing results of examinations of individual samples of shellfish and waters of Chesapeake Bay—Continued.

Date.	Hour.	Number.	Location at which sample was taken.	Depth.	Tide.	Turbidity.	Wind.	Weather.	Salinometer reading.	Temperature.	Colonies per cubic centimeter.		Smallest quantity of water from over bed in which *B. coli* was present.	Score based on *B. coli* in shell liquor.
											From water over bed in agar for 24 hours, at 37 °C.	From shell liquor in agar for 72 hours, at 20 °C.		
			Chester River—Contd.	*Feet.*					*Salinometer.*	°*C.*			*C. c.*	
1915. Jan. 2	12.05 p. m.	21	Bed No. 3, off mouth of Jarretts Creek.	8	Ebb...	0	SE.	Cloudy..	1.0120	1.1	13	2,600	−10	0
	12.15	22	Bed No. 1 ,below red spar No. 7 off Browns Creek.	9	...do...	0	SE.	...do.....	1.0115	1.1	86	6,400	+10	2
	12.45	23	In channel off mouth South East Creek.	2	...do...	0	SE.	...do.....	1.0115	1.1	20	....	+10	....
	1.05	24	In channel off Primrose Point.	2	...do...	0	SE.	...do.....	1.0115	1.1	170	....	+ 1	....
	1.20	25	At dock, Chestertown.	2	...do...	0	SE.	...do.....	1.0075	1.1	630	....	+ .01	....
5	9.35 a. m.	26	Channel below Primrose Point.	2	Flood.	0	SW.	Clear....	1.0100	0.5	200	....	−10	....
	9.50	27	Channel above mouth South East Creek.	2	...do...	0	SW.	...do.....	1.0100	0.5	22	....	+10	....
									Cl. p. p.m.					
1914. Feb. 10	3.15 p. m.	[1] 18992	Between Triangles 5 Q. A. Co. and 87 Kent Co.	15	...do...	70	....	....	4,500	2.2	176	....	+ 1	....
	2.45	[1] 18990	Between Triangle 10 Q. A. Co. and mouth of Jarrett Creek.	24	...do...	20	....	....	5,175	2.6	61	....	−10	
	2.30	[1] 18989	Over Bed 4, Q. A. Co., south of Indian Town Pier.	33	...do...	25	....	....	5,700	2.6	70	....	−10	....
	2.05	[1] 18988	Over Bed 6, Q. A. Co., between Cliffs and Upper Spaniard Point.	33	...do...	10	....	....	5,950	2.6	43	....	+10	....
	11.15 a. m.	[1] 18987	At buoy, mouth of Corsica River.	12	...do...	8	....	....	6,225	2.3	790	....	+10	....
	10.00	[1] 18983	At Can buoy, mouth of Langford Bay.	18	Ebb...	10	....	....	6,350	2.6	88	....	+10	....
	9.25	[1] 18980	Off Piney Point, between buoy and triangle 33 Q. A. Co.	12	...do...	5	....	....	6,175	2.1	180	....	+10	....

	9.00	[1] 18979	Off Hall Point, at buoy 7 off triangle 21 Kent Co.	18	...do...	8	....	....	5,775	2.0	183	....	+ 1	....
	8.35	[1] 18978	Off Panhandle Point, at buoy No. 3.	18	...do...	5	....	....	5,800	2.3	300	....	+10	....
	8.10	[1] 18977	Off Wickes Beach, between beds 28 and 29 Kent Co.	42	...do...	15	....	....	5,875	2.6	250	....	+10	....
	3.00	[1] 18991	Bed 64 Kent Co., off mouth of Jarretts Creek.	8	Flood.	8	....	....	4,850	2.6	72	6,800	−10	1
	2.30	[1] 18989	Bed 4 Q. A. Co., off Mummys Cove.	33	...do...	25	....	....	5,700	2.6	70	310	−10	2
	2.05	[1] 18988	Bed 6 Q. A. Co., off Emory Hollow.	33	...do...	10	....	....	5,950	2.6	43	700	+10	1
	11.10	[1] 18986	Between triangles 21 and 22 Q. A. Co.	11	Ebb...	3	....	....	6,100	2.1	210	....	−10	....
	10.30	[1] 18985	Bed 46 Kent Co., Langford Bay off Drum Point.	20	...do...	3	....	....	6,100	2.2	72	860	−10	2
	10.15	[1] 18984	Bed 43 Kent Co., Langford Bay off Grays Inn Point.	16	...do...	3	....	....	6,500	2.2	82	2,030	−10	23
	9.50	[1] 18982	Bed 39 Kent Co., Bluff Point mouth of Grays Inn Creek.	20	...do...	2	....	....	6,550	2.4	....	1,500	....	3
	9.45	[1] 18981	Bed 14 Q. A. Co., mouth of Reed Creek.	15	...do...	3	....	....	6,500	2.5	39	1,150	−10	2
			Susquehanna River:						Salinometer.					
1915. Mar. 8	4.05 p. m.	13	Off Fishing Battery...	2	Flood.	0	SW.	Clear....	1.0010	3.8	126	....	+10	....
	4.15	14	Red spar No. 8........	2	...do...	0	SW.	...do.....	1.0005	3.8	75	....	+ 1	....
	4.30	15	At dock Havre de Grace.	2	...do...	0	SW.	...do.....	1.0005	3.8	110	....	+ 1	....
9	8.40 a. m.	16	Do................	2	Ebb...	0	SW.	...do.....	1.0005	3.2	42	....	+ 1	....
	8.50	17	Red spar No. 8........	2	...do...	0	SW.	...do.....	1.0005	3.2	34	....	+10	....
	9.05	18	Off Fishing Battery...	2	...do...	0	SW.	...do.....	1.0010	3.2	44	....	+10	....
			Chesapeake Bay:											
1914. May 30	5.30 a. m.	a	Fort Monroe, off quartermaster's wharf.	2	...do..	0	SE.	Fair.....	....	23	135	....	+ 1	....
	6.20	b	1 mile east of Fort Monroe.	2	...do...	0	SE.	...do.....	....	23	9	....	−10	....
	6.40	c	Off Thimble Shoal Lighthouse.	2	...do...	0	SE.	...do.....	....	23	15	....	−10	....
	9.20	d	Off New Point Lighthouse.	2	...do...	0	SE.	....	....	22.8	4	....	−10	....
	9.45	e	Off Wolf Trap Lighthouse.	2	...do...	0	SE.	Fair.....	....	22.2	19	....	+10	....
	1.40 p. m.	f	Off Smith Point Lighthouse.	2	...do...	0	SE.	...do.....	....	23	6	....	−10	....

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Table showing results of examinations of individual samples of shellfish and waters of Chesapeake Bay—Continued.

Date.	Hour.	Number.	Location at which sample was taken.	Depth.	Tide.	Turbidity.	Wind.	Weather.	Salinometer reading.	Temperature.	Colonies per cubic centimeter.		Smallest quantity of water from over bed in which *B. coli* was present.	Score based on *B. coli* in shell liquor.
											From water over bed in agar for 24 hours, at 37° C.	From shell liquor in agar for 72 hours, at 20° C.		
1914.			Chesapeake Bay—Contd.	*Feet.*					*Salinometer.*	°*C.*			*C. c.*	
June 25	4.00 p. m.	h	Off Thomas Point Light.	25	Flood.	0	SE.	Clear....	....	24.5	20	2,200	+10	3
	4.10	i	Off Tolley Point Light buoy.	15	...do...	0	SE.	...do.....	....	24.5	14	200,000	−10	14
26	12.45	[1] 21,829	Off Hackett Point Light, bed No. 15.	18	...do...	3	....	....	Cl. p. p. m. 5,400	25.5	50	32,500	−10	14
	1.05	[1] 21,825	Near Sandy Point Light, bed No. 14.	14	...do...	3	....	....	5,150	25	37	1,850	+10	3
	1.35	[1] 21,826	Above Sandy Point Light, bed No. 12.	16	...do...	3	....	....	4,900	25.5	15	13,000	+10	3
27	3.30	[1] 21,843	1¼ miles south of Hart Island light.	....	...do...	10	....	....	3,900	27.5	15	....	+ 1	....
Dec. 22	3.10	1	Channel abreast Poplar Island.	2	Ebb..	0	N.	Cloudy..	Salinometer. 1.0160	4.7	9	....	−10	....
	3.40	2	Bloody Point Light...	2	...do...	0	NE.	...do.....	1.0150	4.4	6	....	−10	....
	4.00	3	Opposite Thomas Point light.	2	...do...	0	NE.	...do.....	1.0150	4.4	8	....	−10	....
	4.30	4	Greenbury Point Light.	2	Flood.	0	SW.	...do.....	1.0145	3.9	8	....	−10	....
	4.40	5	Sandy Point Light....	2	...do...	0	SW. brisk.	Clear....	1.0145	3.9	41	....	+10	....
	5.00	6	Magothy Light........	2	...do...	0	SW. brisk.	Cloudy..	1.0140	2.8	8	....	+10	....
1915. Jan. 2	3.05	1	Abreast first red buoy above Magothy Light.	18	...do...	0	NW.	Fair.....	1.0135	1.6	12	....	−10	1
	3.20	2	On middle ground abreast black and red light buoy below Bodkin Point.	18	...do...	0	NW.	...do.....	1.0135	1.6	23	1,500	−10	1

	3.40	3	Black buoy below Seven-foot knoll.	18	...do...	0	NW.	...do.....	1.0130	1.6	7	1,300	+10	1
	4.05	4	Abreast inside Seven-foot knoll Light.	2	...do...	0	NW.	...do.....	1.0130	1.6	....	....	−10	....
Feb. 25	10.50 a. m.	46	½ mile off lighthouse lower end of Hart Island.	2	...do...	50	NW. strong.	Clear....	1.0040	6.1	34	....	+10	....
	11.05	47	½ mile off shore between Millers and Harts Island.	2	...do...	50	NW. strong	...do.....	1.0040	6.1	70	....	+ 1	....
	11.15	48	Red buoy off the mouth of Back River, Md.	2	...do...	100	Strong.	...do.....	1.0035	6.1	58	....	+ 1	....
26	11.15	10	Seven-foot Knoll......	2	...do...	50	NW.	...do.....	1.0050	6.1	140	....	+10	....
	11.30	11	Nine-foot knoll between black buoys 3-B and 1-B.	14	...do...	50	NW.	...do.....	1.0050	6.1	66	2,400	+10	0
Mar. 10	1.10 p. m.	1	Near lighthouse at end of Hart Island.	2	...do...	5	NW.	...do.....	1.0040	3.8	103	....	+ 1	....
	1.20	2	Abreast Hart Island..	2	...do...	5	NW.	...do.....	1.0040	3.8	125	....	+ 1	....
	1.28	3	Halfway between Millers Island and red spar No. 2.	2	...do...	5	NW.	...do.....	1.0040	3.8	140	....	+ 1	....
	1.35	4	Off mouth of Back River.	2	...do...	10	NW.	...do.....	1.0040	3.8	164	....	+10	....
	1.45	5	Black light buoy No. 9, off Pooles Island.	2	...do...	15	NW.	...do.....	1.0040	3.8	177	....	+ 1	....
	2.10	6	Bell buoy off Pooles Island.	2	...do...	15	NW.	...do.....	1.0030	3.8	130	....	+ 1	....
	2.30	7	Red buoy off Wortons Point.	2	...do...	15	NW.	...do.....	1.0030	3.8	180	....	+ 1	....
	2.40	8	Abreast black spar No. 5, on middle ground.	2	...do...	15	NW.	...do.....	1.0025	3.8	145	....	+10	....
	3.00	9	Abreast Howell Point.	2	...do...	10	NW.	...do.....	1.0020	3.8	190	....	+10	....
	3.15	10	In channel off Grove Point.	2	...do...	10	NW.	...do....	1.0015	3.8	145	....	+10	....
	3.30	11	Off Turkey Point.....	2	...do...	10	NW.	...do.....	1.0015	3.8	190	....	+ 1	....
	3.45 p. m.	12	At wreck buoy off Spesutie Island.	2	...do...	5	NW.	do.....	1.0010	3.8	160	....	+10	....
9	9.20 a. m.	19	Wreck buoy off Spesutie Island.	2	Ebb ..	0	NW.	...do.....	1.0010	3.2	42	....	+ 1	....
	9.30	20	Off Turkey Point.....	2	...do...	0	NW.	...do.....	1.0010	3.2	50	....	+10	....
	9.45	21	Off Grove Island......	2	...do...	5	NW.	...do.....	1.0010	3.2	33	....	+10	....
	10.05	22	Abreast Howell Point.	2	...do...	25	NW.	...do.....	1.0015	3.2	68	....	+ 1	....
	10.20	23	Abreast black spar No. 5, on middle ground.	2	...do...	25	NW.	...do.....	1.0015	3.2	44	....	+ 1	....
	10.35	24	Red light buoy off Wortons Point.	2	...do...	25	NW.	...do.....	1.0020	3.2	74	....	+10	....
	10.55	25	Bell buoy off Pooles Island.	2	...do...	25	NW.	...do.....	1.0040	3.2	72	....	+ 1	....

[1] Collected by Department of Agriculture and examined by Hygienic Laboratory, Public Health Service.

Table showing results of examinations of individual samples of shellfish and waters of Chesapeake Bay—Continued.

Date.	Hour.	Number.	Location at which sample was taken.	Depth.	Tide.	Turbidity.	Wind.	Weather.	Salinometer reading.	Temperature.	Colonies per cubic centimeter.		Smallest quantity of water from over bed in which *B. coli* was present.	Score based on *B. coli* in shell liquor.
											From water over bed in agar for 24 hours, at 37° C.	From shell liquor in agar for 72 hours, at 20°C.		
1915.			Chesapeake Bay—Contd.	*Feet.*					*Salinometer.*	°*C.*			*C. c.*	
Mar. 9	11.10 a. m.	26	Black light buoy No. 9, below Pooles Island.	2	Ebb	25	NW.	Clear	1.0050	3.2	66	....	+10	....
	11.27	27	Off mouth of Back River.	2	...do...	25	NW.	...do.....	1.0050	3.2	93	....	+ 1	....
	11.30	28	Halfway between Millers Island and red spar No. 2.	2	...do...	25	NW.	...do.....	1.0050	3.2	106	....	+10	....
	11.40	29	Abreast Hart Island	2	...do...	25	NW.	...do.....	1.0050	3.2	126	....	+10	....
	11.50	30	Near lighthouse at end of Hart Island.	2	...do...	25	NW.	...do.....	1.0050	3.2	80	....	+ 1	....
Jan. 5	12.05 p. m.	28	Between red spar No. 22 and Swan Point.	10	...do..	10	NW.	...do....	1.0120	1.6	9	1,900	+10	0
	12.40	29	100 yards west of black buoy off Tolchester Beach.	16	...do...	10	NW.	...do.....	1.0120	1.6	11	700	−10	0
	1.10	30	Middle ground halfway between black spar No. 1 and red spar No. 2.	14	...do...	10	NW.	...do.....	1.0120	1.6	17	3,900	−10	0
	1.25	31	At red spar No. 2, off Hart Island.	12	...do...	10	NW.	...do.....	1.0120	1.6	11	12,500	−10	1
	1.40	32	Middle ground off Tolchester Beach.	16	...do...	10	NW.	...do.....	1.0120	1.6	9	14,200	−10	2
	1.50	33	Middle ground off Swan Point.	12	...do...	10	NW.	...do.....	1.0120	1.6	11	2,100	−10	0
	2.30	34	At black buoy on Nine-foot Knoll.	18	...do...	10	NW.	...do.....	1.0120	1.6	7	1,100	+10	1
11	11.10 a. m.	11	Spar buoy No. B3, on Six-foot Knoll.	14	Flood.	10	SE.	Cloudy..	1.0065	1.1	122	1,100	+ 1	0
	12.25 p. m.	12	On middle ground between Tolchester Beach and Hart Island.	16	...do...	40	SE.	...do.....	1.0060	1.1	155	800	+ 1	0

	1.15	13	....do..................	18	...do...	50	SE.	...do.....	1.0060	1.1	250	800	+ 1	0
	1.30	14	....do..................	18	...do...	50	E.	...do.....	1.0055	1.1	170	60,000	+10	2
	1.40	15	....do..................	12	...do...	50	E.	...do.....	1.0055	1.1	200	1,900	+ 1	2
	1.50	16	Black spar No. 1, off Tolchester Beach.	18	...do...	35	E.	...do.....	1.0060	1.1	190	15,500	+ 1	3
	2.25	17	Red spar No. 22, off Swan Point.	10	...do...	0	E.	...do.....	1.0065	1.1	52	2,600	+ 1	0
2	3.05	1	Abreast first red buoy above Magothy Light.	18	...do...	0	NW.	Fair.....	1.0135	1.6	12	1,400	−10	1
	3.20	2	On middle ground abreast black and red light buoy below Bodkin Point.	18	...do...	0	NW.	...do.....	1.0135	1.6	23	1,500	−10	1
	3.40	3	Black buoy, below Seven-foot Knoll.	18	...do...	0	NW.	...do.....	1.0130	1.6	7	1,300	+10	1
	4.05	4	Abreast and inside seven-foot Knoll Light.	2	Ebb ..	0	NW.	...do.....	1.0130	1.6	11	....	−10	....
									Cl. p.p.m.					
1914. Feb. 5	3.30	[1] 18969	Bed 1, Baltimore Co. and 6 Kent Co.	12	...do ..	....	....	....	....	....	....	510,000	....	41
	3.00	[1] 18970	Bed 3, Baltimore Co., south of Hart Island Light.	17	...do.	....	....	....	....	....	....	122,000	....	32
	8.35 a. m.	[1] 18956	Bed 14, A. A. Co., near Sandy Point Light.	14	Flood.	75	....	....	1,300	2.6	570	230	+ .1	2
	8.10	[1] 18955	Bed 15, A. A. Co., off Hackett Point.	18	...do...	70	....	....	1,400	2.6	620	1,760	+ 1	1
Mar. 13	10.05	[1] 20522	Bed 14, A. A. Co., near Sandy Point Light.	14	Ebb ..	1	....	....	7,250	0.8	23	350	−10	1
	9.55	[1] 20521	Bed 15, A. A. Co., off Hackett Point, upper end.	18	...do...	1	....	....	7,200	0.5	31	875	−10	1
	9.50	[1] 20520	Bed 15, A. A. Co., off Hacket Point, lower end.	15	...do...	3	....	....	7,300	0.7	13	525	−10	2
Feb. 4	1.50 p. m.	[1] 18952	Bed 90, A. A. Co., at Fairhaven in Herring Bay.	8	...do...	2	....	....	6,300	6.2	8	....	−10	....
	1.45	[1] 18951	Bed 89, A. A. Co., Herring Bay, lower end of bed.	8	...do...	2	....	....	6,350	5.6	15	....	−10	....
	1.30	[1] 18950	Bed 91, A. A. Co., off Holland Point.	12	...do...	2	....	....	6,350	5.0	15	9,400	−10	4
	2.25	[1] 18953	Bed 1, Calvert Co., opposite North Chesapeake Beach.	27	...do...	2	....	....	6,750	5.6	13	....	−10	....
	2.40	[1] 18954	Bed 2, Calvert Co., off Chesapeake Beach Steamboat Wharf.	26	...do...	3	....	....	6,550	5.8	19	....	−10	....

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[1] Collected by Department of Agriculture and examined by Hygienic Laboratory, Public Health Service.

Table showing results of examinations of individual samples of shellfish and waters of Chesapeake Bay—Continued.

Date.	Hour.	Number.	Location at which sample was taken.	Depth.	Tide.	Turbidity.	Wind.	Weather.	Salinometer reading.	Temperature.	Colonies per cubic centimeter.		Smallest quantity of water from over bed in which *B. coli* was present.	Score based on *B. coli* in shell liquor.
											From water over bed in agar for 24 hours, at 37° C.	From shell liquor in agar for 72 hours, at 20° C.		
			Back River, Md.:	*Feet.*					*Salinometer.*	°*C.*			*C. c.*	
1914 Dec. 23	1.12 p. m.	20	Below Lynch Point (ice solid over river).	([2])	Ebb	......	NW.	Very cold, clear.	1.009	0.5	500	......	− 0.1	......
	1.20	21	300 yards above Rocky point.	([2])	...do	......	NW.	...do	1.009	.5	700	......	− .1	......
	1.25	22	Red Buoy off Rocky Point.	2	...do	......	NW.	...do	1.009	.5	400	......	+ .1	......
	1.30	23	Half way between Nos. 22 and 24.	2	...do	......	NW.	...do	1.009	.5	150	......	− .1	......
	1.40	24	Off red buoy No. 2	2	...do	......	NW.	...do	1.0110	.5	300	......	− .1	......
	1.50	25	Black spar buoy No. 1 at entrance.	2	...do	......	NW.	...do	......	.5	65	......	+ 1	......
	2.20	26	Outside island, 250 yards off Range Light at inlet between island.	2.8	...do	0	NW.	...do	1.0125	2.5	1,000	......	+ .01	......
1915 Feb. 25	11.25 a. m.	49	Red buoy No. 2, off Wells Point.	2	Flood.	40	NW.	Clear	1.0030	6.1	160	......	− 1	......
	11.40	50	Red buoy No. 4	2	...do	25	NW.	...do	1.0020	6.1	200	......	+ 1	......
	11.45	51	Off mouth of creek above Rocky Point.	2	...do	60	NW.	...do	1.0020	6.6	300	......	+ 1	......
	11.55	52	Middle of broad water between Cuckhold Point and Porters Bar.	2	...do	75	NW.	...do	1.0020	6.1	1,100	......	+ 1	......
									Cl. p. p. m.					
1914. June 27	12.50 p. m.	[1]21837	Between Cox and Wetherby Points.	......	...do	60	......	......	455	27.5	......	......	+ .0001	......
	1.10	[1]21838	Off Stansbury Point	......	...do	35	......	......	1,300	27	850	......	+ .1	......
	1.30	[1]21839	Between Porters Bar and Lynch Point.	......	...do	60	......	......	1,600	28.5	750	......	+ 1	......

	1.55	[1] 21840	Between Rocky Point and Cuckhold Point.	....	...do..	10	....	....	2,000	28.7	95	....	− 1	....
	2.10	[1] 21841	Opposite gap between Hart and Millers Island.	....	...do..	15	....	....	2,150	27.5	125	....	− 1	....
	2.45	[1] 21842	Black spar at end of Millers Island (river mouth).	....	...do..	15	....	....	3,100	27.5	145	....	+ 1	....
Feb. 5	2.50	[1] 18968	Between Cox and Wetherby Points.	6	...do..	150	....	....	1,800	6.2	1,500	....	+ .1	....
	2.30	[1] 18967	Off Stansbury Point..	9	...do..	80	....	....	2,500	4.9	1,230	....	+ .1	....
	2.10	[1] 18966	Between Porters Bar and Lynch Point.	10	...do..	60	....	....	2,300	4.2	720	....	+10	....
	1.50	[1] 18965	Between Rocky Point and Cuckold Point.	30	...do..	60	....	....	2,200	4.2	580	....	− .1	....
	1.40	[1] 18964	Opposite gap between Hart and Millers Island.	9	...do..	90	....	....	1,300	3.2	820	....	+ 1	....
	1.15	[1] 18963	At mouth of gap, near Hart Island Lighthouse.	3	...do..	30	....	....	1,000	2.6	900	....	− 1	....
	1.05	[1] 18962	One mile and a half south of Hart Island Light.	15	...do..	50	....	....	1,100	2.6	1,140	....	+10	....
Apr. 10	10.30 a. m.	[1] 21807	Between Cox and Wetherby Points.	6	Ebb...	150	....	....	1,000	9.8	80,000	....	+ .001	....
	10.10	[1] 21806	Off Stansbury Point..	9	...do..	80	....	....	1,700	9.0	1,600	....	+ .1	....
	9.55	[1] 21805	Between Porters Bar and Lynch Point.	10	...do..	60	....	....	1,650	8.6	200	....	− .1	....
	9.30	[1] 21804	Between Rocky Point and Cuckhold Point.	30	...do..	30	....	....	1,305	8.8	4,200	....	− .1	....
	9.15	[1] 21803	Opposite gap between Hart and Millers Island.	9	...do..	30	....	....	1,145	8.2	1,300	....	− .1	....
	8.20	[1] 21802	One mile and a half south of Hart Island Light.	15	...do..	70	....	....	365	7.8	9,500	....	− .1	....
1915.			Baltimore Harbor abreast:						Salinometer.					
Feb. 26	9.35	1	Pier No. 2, Pratt Street	2	...do...	15	NW.	Clear....	1.0070	6.1	2,700	....	+ .1	....
	9.45	2	Chase's wharf (B. & O.)	2	...do..	15	NW.	...do....	1.0070	6.1	3,000	....	+ .001	....
	9.50	3	North German Lloyd docks.	2	...do..	15	NW.	...do....	1.0065	6.1	2,000	....	+ .01	....
	10.05	4	Abreast Fort McHenry	2	Flood	15	NW.	...do....	1.0060	6.1	2,200	....	+ .1	....
1914.			Patapsco River, Md.:						Cl.p.p.m.					
Feb. 6	10.00	[1] 18976	Between Lazarette Point and Fort McHenry.	35	Ebb...	10	....	....	1,025	3.8	1,000	....	+ 1	....

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[1] Collected by Department of Agriculture and examined by Hygienic Laboratory, Public Health Service.

[2] Bottom.

Table showing results of examinations of individual samples of shellfish and waters of Chesapeake Bay—Continued.

Date.	Hour.	Number.	Location at which sample was taken.	Depth.	Tide.	Turbidity.	Wind.	Weather.	Salinometer reading.	Temperature.	Colonies per cubic centimeter.		Smallest quantity of water from over bed in which *B. coli* was present.	Score based on *B. coli* in shell liquor.
											From water over bed in agar for 24 hours, at 37° C.	From shell liquor in agar for 72 hours, at 20° C.		
1914.			Patapsco River, Md.—Con.	*Feet.*					*Cl.p.p.m.*	°*C.*			*C. c.*	
Feb. 6	9.40 a. m.	[1] 18975	Between gas buoy No. 7-M and spar buoy No. 8-M.	35	Ebb	20	....	....	3,375	3.8	1,300	....	+ 1	....
	9.25	[1] 18974	Between Fort Carroll Light, cable can 21½, and gas buoy No. 3-M.	35	..do	8	....	....	4,300	3.8	7,600	....	+ 1	....
	9.05	[1] 18973	Off Sparrow Point, at spar buoy No. 28.	35	..do	30	....	....	3,075	3.4	2,300	....	+ 1	....
	8.45	[1] 18972	In channel between spar buoy No. 22 and can No. 19½.	35	..do	25	....	....	3,800	3.4	10,000	....	+ 10	....
	8.30	[1] 18971	At intersection of old and new channels.	35	..do	40	....	....	1,910	2.6	14,000	....	+ 1	....
Mar. 13	4.35 p. m.	[1] 20533	Between Lazarette Point and Fort McHenry.	35	Flood	5	....	....	5,950	1.2	68	....	+ 1	....
	4.15	[1] 20532	Between gas buoy No. 7-M and spar buoy No. 8-M.	35	..do	8	....	....	5,700	1.2	59	....	+10	....
	3.55	[1] 20531	Between Fort Carroll, cable can No. 21½, and gas buoy No. 3-M.	35	..do	2	....	....	5,850	1.2	43	....	+ 1	....
	3.35	[1] 20530	Off Sparrow Point, at spar buoy No. 28.	35	..do	3	....	....	6,050	1.2	50	....	+10	....
	3.15	[1] 20529	In channel between spar buoy No. 22 and can No. 19½.	35	..do	5	....	....	6,350	1.2	44	....	−10	....
	3.00	[1] 20528	At intersection of old and new channels.	35	..do	5	....	....	5,550	1.2	52	....	−10	....
Apr. 10	6.50	[1] 21813	Between Lazarette Point and Fort McHenry.	35	..do	15	....	....	2,300	8.8	1,800	....	+.1	....

	6.35	[1] 21812	Between gas buoy No. 7-M and spar buoy No. 8-M.	35	...do...	15	....	....	2,250	8.8	800	....	+ .01	....
	6.15	[1] 21811	Between Fort Carroll, cable can No. 21½, and gas buoy No. 3-M.	35	...do...	20	....	....	2,100	8.6	800	....	− .1	....
	6.00	[1] 21810	Off Sparrow Point, at spar buoy No. 28.	35	...do...	25	....	....	1,720	8.6	600	....	− .1	....
	5.45	[1] 21809	In channel between spar buoy No. 22 and can No. 19½.	35	...do...	50	....	....	1,070	8.6	115,000	....	− .1	....
	5.30	[1] 21808	At intersection of old and new channels.	35	...do...	50	....	....	810	8.4	900	....	+ .1	....
June 26	8.20 a. m.	[1] 21831	Between Lazarette Point and Fort McHenry.	35	Ebb...	20	....	....	4,050	25.3	2,750	....	+ .01	....
	8.45	[1] 21832	Between gas buoy No. 7-M and spar buoy No. 8-M.	35	...do...	5	....	....	3,800	25.7	330	....	− 1	....
	9.10	[1] 21833	Between Fort Carroll, cable can No. 21½, and gas buoy No. 3-M.	35	...do...	8	....	....	3,900	25.7	200	....	+ 1	....
	9.30	[1] 21834	Off Sparrow Point, at spar buoy No. 28.	35	...do...	3	....	....	3,900	25.8	125	....	− 1	....
	9.45	[1] 21835	In channel between spar buoy No. 22 and can No. 19½.	35	...do...	15	....	....	4,150	25.0	110	....	− 1	....
	10.00	[1] 21836	At intersection of old and new channels.	35	...do...	13	....	....	4,200	25.0	80	....	− 1	....
	4.30 p. m.	[1] 21844	In Baltimore channel at buoy No. 9-C.	35	Flood.	15	....	....	5,750	27.0	10	....	− 1	....
1915. Feb. 26	4.35	5	Off Sparrow Point, channel buoy No. 8B	2	...do...	15	NW.	Clear....	Salinometer. 1.0060	1.5	11	....	+10	....
	4.30	6	Abreast Fort Carroll..	2	...do...	15	NW.	...do.....	1.0125	1.5	20	....	− 1	....
	5.15	7	Abreast Fort McHenry.	2	...do...	15	NW.	...do.....	1.0120	1.5	490	....	+ .01	....
	5.30	8	At B. & O. wharf west of Broadway.	2	...do...	15	NW.	...do.....	1.0120	1.5	440	....	+ .1	....
	7.40 a. m.	10	Off Fort Carroll in channel.	2	...do...	15	NE.	Cloudy..	1.0125	1.1	15	....	+10	....
	7.50	11	Off Sparrow Point buoy No. 8B in channel.	2	...do...	15	NE.	...do.....	1.0130	1.1	9	....	+ 1	....
	8.15	12	Off Fort Howard buoy No. 2B, in channel.	2	...do...	15	NE.	...do.....	1.0130	1.1	8	....	+10	....
	8.30	13	Abreast 7-foot knoll...	2	...do...	15	NE.	...do.....	1.0130	1.1	10	....	−10	....

[1] Collected by Department of Agriculture and examined by Hygienic Laboratory, Public Health Service.

Table showing results of examinations of individual samples of shellfish and waters of Chesapeake Bay—Continued.

Date.	Hour.	Number.	Location at which sample was taken.	Depth.	Tide.	Turbidity.	Wind.	Weather.	Salinometer reading.	Temperature.	Colonies per cubic centimeter.		Smallest quantity of water from over bed in which *B. coli* was present.	Score based on *B. coli* in shell liquor.
											From water over bed in agar for 24 hours, at 37° C.	From shell liquor in agar for 72 hours, at 20° C.		
1914.			Patapsco River, Md.—Con.	*Feet.*					*Salinometer.*	°*C.*			*C. c.*	
Dec. 22	5.15 p. m.	7	5 miles below Seven Foot Knoll.	2	Flood.	15	SW.	Cloudy..	1.0135	1.7	7	....	+ 1	....
	5.40	8	Off Seven Foot Knoll.	2	...do...	15	SW.	...do.....	1.0130	1.7	70	....	− 1	....
	6.05	9	Off Lazarette Point...	2	...do...	15	SW.	...do.....	1.0130	1.7	50	....	− 1	....
23	7.05 a. m.	10	Baltimore Harbor...	2	...do...	15	SW.	...do.....	1.0120	3.3	900	....	+ .1	....
	8.45	12	Off B. & O. coal docks.	2	Ebb...	15	SW.	Clear....	1.0115	2.8	1,200	....	+ .01	....
	8.50	13	Off North German Lloyd.	2	...do...	15	SW.	...do.....	1.0115	2.8	900	....	+ .001	....
	9.55	14	Off Fort McHenry.	2	...do...	15	SW.	...do.....	1.0115	1.7	1,050	....	+ .1	....
	10.52	15	1 mile off Fort McHenry.	2	...do...	15	SW.	...do.....	1.0115	1.7	450	....	+ .1	....
	10.05	16	Buoy No. 10M........	2	...do...	15	SW.	...do.....	1.0115	1.7	260	....	+ .1	....
	11.15	17	Opposite Fort Carroll..	2	...do...	15	SW.	...do.....	1.0120	1.5	125	....	+ 1	....
	11.35	18	Opposite No. 6B red buoy.	2	...do...	15	SW.	...do.....	1.0120	1.5	Spr.......	....	− 1	....
	12.00	19	Opposite Seven Foot Knoll.	2	...do...	15	SW.	...do.....	1.0120	1.0	40	....	− 1	....
									Cl. p. p. m.					
June 27	8.20	31	Between Lazarette Point and Fort McHenry.	2	...do...	20	....	....	4,050	24.7	2,750	....	+ .01	....
	8.45	32	Between gas buoy No. 7-m and spar No. 8-m.	2	...do...	5	....	....	3,800	....	320	....	+ 1	....
	9.10	33	Between gas buoy No. 3-m and Fort Carroll.	2	...do...	8	....	....	3,900	....	200	....	+ 1	....
	9.30	34	Spar buoy No. 28 off Sparrows Point.	2	...do...	3	....	....	3,900	....	125	....	− 1	....
	9.45	35	Between spar No 22 and can No. 19½.	2	...do...	15	....	....	4,150	....	110	....	− 1	....
	10.00	36	Spar buoy at intersection of old and new channels.	2	...do...	13	....	....	4,200	....	80	....	− 1	....

	4.30 p. m.	44	Gas Buoy No. 9C......	2	Flood.		15	....	....	5,750 Salinometer.	....	10	....	− 1	....
1915. Feb. 24	11.30 a. m.	32	Red light buoy No. 12m.	2	...do...	....		NE.	Rain....	1.0035	6.1	220	....	+ 1	....
	11.40	33	Black light buoy No. 9m.	2	...do...	....		NE.	...do.....	1.0040	6.1	120	....	+ 1	....
	11.50	34	Abreast Fort Carroll..	2	...do...	....		NE.	...do.....	1.0040	6.1	45	....	+10	....
	12.00	35	Abreast Sparrows Point red light buoy No. 12-B.	2	...do...	....		NE.	...do.....	1 0040	6.1	65	....	+ 1	....
	12.20 p. m.	36	Abreast Fort Howard.	2	...do...	....		NE.	...do.....	1.0040	6.1	54	....	+ .1	....
	12.40	37	Abreast seven foot knoll.	2	...do...	....		NE.	...do.....	1.0040	6.1	62	....	+ 1	....
25	9.10 a. m.	38	Abreast pier No. 2 Pratt Street.	2	Ebb...		75	NW.	Clear....	1.0035	6.6	1,000	....	+ .1	....
	9.22	39	Abreast Fort McHenry.	2	...do...		60	NW.	...do.....	1.0040	6.6	1,600	....	+ .01	....
	9.35	40	Abreast red light buoy No. 12m.	2	...do...		50	NW.	...do.....	1.0035	6.6	1,360	....	+ .1	....
	9.40	41	Abreast red light buoy No. 9-m. off Wagners Point.	2	...do...		100	NW.	...do.....	1.0035	6.6	500	....	+ .1	....
	9.55	42	Abreast Fort Carroll...	2	...do..		10	NW.	...do.....	1.0040	6.6	65	....	+ .1	....
	10.05	43	Abreast Sparrows Point red light buoy No. 12-B.	2	Flood.		10	NW.	...do.....	1.0040	6.6	42	....	+ 1	....
	10.15	44	Abreast Fort Howard red light buoy No. 2-B.	2	...do...		10	NW.	...do.....	1.0045	6.1	50	....	+ 1	....
	10.35	45	Halfway between Middle ground light and North Point.	2	...do...		50	NW.	...do.....	1.0040	6.1	41	....	+ .1	....
26	10.05	5	Red light buoy No. 12-m.	2	..do...		25	NW.	...do.....	1.0055	5.5	....	....	+ .01	....
	10.10	6	Black buoy No. 9-m. off Wagners Point.	2	...do..		25	NW.	...do....	1.0050	6.1	820	....	+ .01	....
	10.20	7	Abreast Fort Carroll...	2	...do...		15	NW.	...do.....	1.0050	6.1	360	....	+ .1	....
	10.30	8	Abreast Sparrows Point red light bouy No. 12-B.	2	...do...		15	NW.	...do.....	1.0050	6.1	238	....	+ .1	....
	10.45	9	Abreast Fort Howard red Nun buoy No. 2-B.	2	...do...		35	NW.	...do.....	1.0050	6.1	88	....	+ 1.0	....
27	12.40 p. m.	14	Abreast red light buoy No. 12-M.	2	...do...		25	NW.	Fair.....	1.0065	5.5	250	....	+ .01	....
	12.45	15	Abreast black light buoy No. 9-M off Wagners Point.	2	...do...		25	NW.	...do.....	1.0050	5.0	240	....	+ .1	....
	12.55	16	Abreast Fort Carroll...	2	...do...		15	NW.	...do.....	1.0050	5.0	240	....	+ 1.0	....

Table showing results of examinations of individual samples of shellfish and waters of Chesapeake Bay—Continued.

Date.	Hour.	Number.	Location at which sample was taken.	Depth.	Tide.	Turbidity.	Wind.	Weather.	Salinometer reading.	Temperature.	Colonies per cubic centimeter.		Smallest quantity of water from over bed in which *B. coli* was present.	Score based on *B. coli* in shell liquor.
											From water over bed in agar for 24 hours, at 37° C.	From shell liquor in agar for 72 hours, at 20° C.		
			Patapsco River, Md.—Con.	*Feet.*					*Salinometer.*	°*C.*			*C. c.*	
1915. Feb. 27	1.05 p. m.	17	Abreast Sparrows Point red light buoy No. 12-B.	2	Flood.	25	NW.	Fair....	1.0050	5.0	88	....	+ 1.0	....
	1.20	18	Abreast Fort Howard red Nun buoy No. 2-B.	2	...do...	60	NW.	...do.....	1.0050	5.5	110	....	+ .1	....
	1.40	19	Seven foot knoll lighthouse.	2	...do...	85	NW.	...do.....	1.0040	....	83	....	+10	....
			Magothy River:						Cl. p. p. m.					
1914. Feb. 5	9.45 a. m.	[1] 18957	North Ferry Point and Cyprus Point.	13	Flood.	2	....	....	5,200	5.1	126	....	−10	....
	10.00	18958	Between Ulmstead and Park Points.	15	...do...	25	....	....	4,450	4.8	255	....	+10	....
	10.35	[1] 18960	Between Triangles 8 and 22 Anne Arundel Co.	12	...do...	35	....	....	4,050	4.4	820	....	+10	....
	10:20	[1] 18959	In Sillery Bay off Hickory Barr.	12	...do...	25	....	....	4,300	4.1	290	....	+ 1	....
	10.55	[1] 18961	At mouth off Can buoy No. 2.	6	...do...	100	....	....	1,050	2.6	1,290	....	+ 1	....
Mar. 13	12.15 p. m.	[1] 20527	Between North Ferry Point and Cypress Point.	18	Ebb..	5	....	....	6,500	1.9	21	....	+10	....
	12.00 a. m.	[1] 20526	Between Ulmstead and Park Point.	15	...do...	2	....	....	6,300	1.4	21	....	−10	....
	11.35	[1] 20525	In Sillery Bay off Hickory Bar.	12	...do...	2	....	....	6,500	1.6	18	....	−10	....
	11.15	[1] 20524	Between Triangles 8 and 22, Anne Arundel Co.	15	...do...	7	....	....	6,150	0.8	24	....	−10	....
June 26	2.35 p. m.	[1] 21827	Between North Ferry Point and Cypress Point.	18	Flood.	5	....	....	4,300	27.5	58	16,500	+10	4

	4.20	[1] 21828	Between Ulmstead and Park Point.	15	...do...	15	....	....	4,550	26.5	[illegible]	....	+10	....
	4.40	[1] 21829	Between Triangles 8 and 22, Anne Arundel Co.	15	...do...	40	....	....	4,600	25.8	250	....	+10	....
	4.55	[1] 21830	At mouth off Can buoy No. 2	6	...do...	20	....	....	4,900	25.0	60	....	+ 1	....
Mar. 13	11.00 a. m.	[1] 20523	At mouth off Can buoy No. 2.	6	Ebb..	10	....	....	9,000	1.1	36	....	−10	....
Sept. 18	9.15	a	Broad Creek, bed 8...	8	...do...	0	SW.	Clear....	....	20	17	1,200	+ 1	4
	9.25	b	Ulmstead Point, bed 9.	8	...do...	0	SW.	...do....	....	20	105	4,700	−10	4
	10.05	c	Inside Mountain Point bed 5.	8	...do...	0	SW.	...do....	....	20	11	3,900	−10	3
	10.35	d	Mouth of river, outside Black buoy, bed 12.	8	...do...	0	SW.	...do....	....	20	10	1,300	+10	2
	10.55	e	Above mouth of river, outside Black buoy, bed 4.	10	...do...	0	SW.	...do....	....	20	10	2,000	+10	1
			Severn River:											
Feb. 2	2.40 p. m.	[1] 18929	Off triangle No. 45, Anne Arundel Co., upper end Round Bay on Cedar Point.	21	...do...	10	....	....	7,000	4.8	20	....	− 1	....
	2.20	[1] 18928	Triangle No. 43, north side entrance Ringold Cove.	24	...do...	12	....	....	7,150	4.6	300	....	+ 1	....
	2.00	[1] 18927	Triangle No. 50, Brewer Point, north mouth Brewer Creek.	24	...do...	3	....	....	7,250	4.6	12	....	+10	....
	1.40	[1] 18925	Triangle No. 38, point between Chase and Cool Spring Creek.	24	...do...	0	....	....	7,250	4.8	7	....	+10	....
	1.15	[1] 18923	Between Triangle Nos. 35 and 55, between bridges.	21	...do...	0	....	....	7,200	5.0	13	....	+10	....
	12.00	[1] 18921	Between triangles Nos. 33 and 62, in channel.	18	...do...	0	....	....	7,000	4.4	20	....	+ 1	....
	11.55 a. m.	[1] 18918	Outside Greenbury light near buoy.	33	...do...	3	....	....	7,050	4.2	15	....	+ 1	....
	1.10 p. m.	[1] 18922	Between mooring buoys off Santee wharf.	30	...do...	3	....	....	7,250	4.6	70	....	+10	....
	11.30 a. m.	[1] 18920	In channel at buoy No. 5.	18	...do...	8	....	....	5,550	3.4	28	....	+ 1	....
Mar. 12	4.35 p. m.	[1] 20512	Off triangle No. 45, Anne Arundel Co., upper end Round Bay on Cedar Point.	21	Flood.	50	....	....	6,700	1.2	10	....	−10	....

[1] Collected by Department of Agriculture and examined by Hygienic Laboratory, Public Health Service.

Table showing results of examinations of individual samples of shellfish and waters of Chesapeake Bay—Continued.

Date.	Hour.	Number.	Location at which sample was taken.	Depth.	Tide.	Turbidity.	Wind.	Weather.	Salinometer reading.	Temperature.	Colonies per cubic centimeter.		Smallest quantity of water from over bed in which *B. coli* was present.	Score based on *B. coli* in shell liquor.
											From water over bed in agar for 24 hours, at 37° C.	From shell liquor in agar for 72 hours, at 20° C.		
1914.			Severn River—Continued.	*Feet.*					*Cl. p. p. m.*	*°C.*			*C. c.*	
Mar. 12	4.20 p. m.	[1]20511	Triangle No. 43, north side entrance Ringold Cove.	24	Flood.	2	....	....	6,700	1.2	8	....	−10	....
	4.05	[1]20510	Triangle No. 50 Brewer Point, north mouth Brewer Creek.	24	...do...	1	....	....	6,800	1.6	21	....	−10	....
	3.45	[1]20509	Triangle No. 38, point between Chase and Cool Spring Creek.	24	...do...	2	....	....	6,950	1.2	34	....	−10	....
	3.35	[1]20508	Between triangles Nos. 35 and 55, between bridges.	21	...do...	4	....	....	7,100	1.2	43	....	+ 1	....
	3.15	[1]20506	Between mooring buoys off Santee wharf.	30	...do...	2	....	....	7,200	1.4	41	....	+10	....
13	8.35 a. m.	[1]20514	Off triangles Nos. 33 and 62, in channel.	18	Ebb...	2	....	....	7,150	0.2	18	....	−10	....
	8.55	[1]20516	Outside Greenbury Point light near buoy.	33	...do...	10	....	....	8,400	0.6	16	....	− 1	....
	9.05	[1]20518	Channel at buoy No. 5.	18	...do...	2	....	....	8,300	0.6	19	....	+10	....
Apr. 9	10.25	[1]20597	Off triangle No. 50, Brewer Point, north of mouth of Brewer Creek.	24	...do...	5	....	....	3,800	9.0	96	....	+ 1	....
	10.10	[1]20596	Off triangle No. 38, Anne Arundel Co., point between Chase and Cool Spring Creeks.	24	...do...	30	....	....	3,900	8.8	113	....	+10	....
	9.50	[1]20595	Off triangles Nos. 35 and 55, between bridges.	21	...do...	15	....	....	3,600	8.6	182	....	+10	....
	9.35	[1]20594	Off triangle No. 34, between mooring	30	...do...	15	....	....	3,600	8.8	192	....	+ 1	....

			buoys off Santee wharf.											
	11.10	[1] 20596	Annapolis Harbor off wall front Naval Academy.	12	...do...	10	....	....	3,180	8.8	450	....	+ .1	....
	12.55 p. m.	[1] 20599	Between triangles Nos. 33 and 62, A. A. Co., in channel.	18	...do...	20	....	....	2,950	8.8	1,700	....	+ .1	....
	1.05	[1] 20600	Outside Greenbury Point light, near buoy.	33	Flood.	30	....	....	3,430	7.6	100	....	− .1	....
	1.20	[1] 21801	In channel at buoy No. 5.	18	...do...	30	....	....	2,900	7.6	800	....	− .1	....
			MISCELLANEOUS SERIES.											
Feb. 2	3.10	[1] 18930	Bed No. 34, A. A. Co., at Big Island, in Little Round Bay.	10	Ebb ..	3	....	....	7,250	4.8	13	....	−10	....
	1.50	[1] 18926	Bed No. 37, A. A. Co., Clem Point, off triangle No. 51.	10	...do...	3	....	....	7,250	5.0	125	2,450	−10	32
	1.30	[1] 18924	Bed. No. 26 A. A. Co., Traces Hollow, off triangle No. 36.	16	...do...	5	....	....	7,250	5.0	24	1,360	− 1	23
	10.30 a. m.	[1] 18916	Bed No. 23, Creces Cove, off triangle No. 34.	21	...do...	3	....	....	7,250	5.2	46	1,680	+ 1	14
	11.00	[1] 18917	Bed No. 19, White Hall, off Greenbury Point light.	12	...do...	3	....	....	5,800	3.6	18	610	−10	32
	11.20	[1] 18919	Bed No. 44, Chinks Point, A. A. Co.	12	...do...	3	....	....	5,650	3.4	31	660	− 1	140
	11.30	[1] 18920	Bed No. 45, Tolly Point, A. A. Co., upper end of bed.	18	...do...	8	....	....	5,550	3.4	28	500	+ 1	4
Mar. 12	4.45 p. m.	[1] 20513	Bed No. 34, A. A. Co., at Big Island, in Little Round Bay.	19	Flood.	1	....	....	6,400	1.9	11	....	−10	....
	3.25	[1] 20507	Bed No. 23, A. A. Co., off triangle No. 34.	21	...do...	0	....	....	7,100	1.2	30	1,550	+10	0
	3.45	[1] 20509	Bed No. 27, Lower Rock Point, A. A. Co.	24	...do...	2	....	....	6,950	1.2	34	2,300	−10	2
	3.05	[1] 20505	Bed No. 43, Horn Point, A. A. Co.	12	...do...	1	....	....	7,050	1.2	33	3,120	+10	0
	8.45 a. m.	[1] 20515	Bed No. 19, White Hall, off Greenbury Point light.	12	Ebb ..	3	....	....	6,850	0.2	15	530	−10	2

[1] Collected by the Department of Agriculture and examined by the Hygienic Laboratory, Public Health Service.

Table showing results of examinations of individual samples of shellfish and waters of Chesapeake Bay—Continued.

Date.	Hour.	Number.	Location at which sample was taken.	Depth.	Tide.	Turbidity.	Wind.	Weather.	Salinometer reading.	Temperature.	Colonies per cubic centimeter.		Smallest quantity of water from over bed in which *B. coli* was present.	Score based on *B. coli* in shell liquor.
											From water over bed in agar for 24 hours, at 37° C.	From shell liquor in agar for 72 hours, at 20° C.		
			MISCELLANEOUS SERIES—continued.											
1914			Severn River—Continued.	*Feet.*					*Cl. p. p. m.*	*°C.*			*C. c.*	
Mar. 12	9.20 a. m.	[1] 20519	Bed No. 45, Tolly Point, lower end of bed.	14	Ebb..	1	....	....	6,950	0.2	15	600	−10	0
	9.00	[1] 20517	Bed No. 45, Tolly Point, upper end of bed.	18	...do...	2	....	....	7,000	0.4	32	1,500	−10	2
June 25	2.30 p. m.	[1] 21814	Cedar Point, upper end of Round Bay.	....	Flood.	10	....	....	4,700	24.7	52	....	+10	....
	2.50	[1] 21815	North side of entrance to Ringold Cove.	....	...do..	35	....	....	4,900	24.2	12	....	+10	....
	3.05	[1] 21816	Brewer Point north of mouth to Brewer Creek.	....	...do..	3	....	....	5,250	23.8	80	....	+10	....
	3.20	[1] 21817	On point between Chase and Cool Spring Creeks.	....	...do..	5	....	....	4,900	26	110	....	+10	....
	3.40	[1] 21818	Between railroad and highway bridges.	....	...do..	3	....	....	5,150	25.5	65	....	+10	....
	3.55	[1] 21819	Between mooring buoys off Santee wharf.	....	...do..	30	....	....	5,300	25	1,100	....	+ .1	....
26	11.20 a. m.	[1] 21820	Between triangles Nos. 33 and 62 in channel.	18	Ebb...	30	....	....	5,850	23.5	600	....	+ 1	....
	11.35	[1] 21821	Off Tolly Point, bed No. 45.	18	...do..	5	....	....	5,750	23.5	13	34,000	+10	23
	12.05 p. m.	[1] 21822	Off Chinks Point, bed No. 44.	12	...do..	5	....	....	5,850	23.5	110	65,000	+ 1	14
	12.15	[1] 21823	Off Greenbury Point Light, bed No. 19.	12	...do..	12	....	....	D. O. p.p.m.	23.5	26	27,500	+ 1	2
Sept. 16	8.40 a. m.	a	Off Eagle Nest Point, bed No. 32.	6	Flood.	0	NW.	Clear....	6.80	21	9	11,300	+10	3
	9.05	b	Off Astquiths Creek, bed No. 31.	10	...do..	0	NW.	...do....	8.15	21	23	11,000	+ 1	3

	10.20	c	Opposite mouth Saltwork Creek, bed No. 27.	28	...do..	0	NW.	...do....	8.40	21	31	2,500	−10	4
	10.05	d	Mouth of Luce Creek bed No. 39.	12	...do..	0	NW.	...do....	8.15	21	34	300	+10	1
	10.45	e	Above and opposite to Weems Creek, bed No. 26.	10	...do..	0	NW.	...do....	8.10	21	46	1,000	+ 1	3
	10.50	f	100 yards above railroad bridge.	3	...do..	0	NW.	...do....	8.35	21	55	....	+ 1	....
	11.05	g	100 yards below highway bridge.	3	...do..	0	NW.	...do....	8.40	21	47	....	+ 1	
	11.20	h	Abreast U. S. S. Reina Mercedes at U. S. N. A.	3	...do..	0	NW.	...do....	8.35	21	145	....	+ .1	....
	11.30	i	At black can buoy No. 13.	3	...do..	0	NW.	...do....	8.50	21	40	....	+ 1	....
	11.45	k	At black can buoy No. 9 opposite Greenbury Point Light.	3	...do..	0	NW.	...do....	8.45	21	18	....	+10	....
17	1.30 p. m.	a	Off Eagle Nest Point..	3	Ebb...	0	NW.	...do....	....	21.5	46	....	+10	....
	1.40	b	Off Astquiths Creek...	3	...do..	0	NW.	...do....	....	21.5	34	....	+10	....
	1.55	c	Off mouth Saltwork Creek.	3	...do..	0	NW.	...do....	....	21.5	59	....	+10	....
	2.12	d	Above mouth Weems Creek.	3	...do..	0	NW.	...do....	....	21.5	79	....	+ 1	....
	2.20	e	Railroad bridge, 100 yards.	3	...do..	0	NW.	...do....	....	21.5	54	....	+10	....
	2.30	f	Below highway bridge, 100 yards.	3	...do..	0	NW.	...do....	....	21.5	90	....	+10	....
	2.40	g	Opposite Reina Mercedes.	3	...do..	0	NW.	...do....	....	21.5	105	....	+ 1	....
	2.50	h	Black can buoy No. 13.	3	...do..	0	NW.	...do....	....	21.5	82	....	−10	....
	3.05	i	Black can buoy No. 9.	3	...do..	0	NW.	...do....	....	21.5	59	....	+10	....
19	8 a. m.	a	Below highway bridge, bed No. 24.	10	...do..	0	N.	...do....	....	20	39	1,300	+ 1	14
	8.20 a. m.	b	Inside Greenbury Point, bed No. 22.	10	...do..	0	N.	...do....	....	20	43	3,000	+ 1	3
	8.45	c	Outside Greenbury Point, bed No. 19.	14	...do..	0	N.	...do....	....	20	32	4,900	+10	1
	8.55	d	Inside Tolly Point, bed No. 44.	15	...do..	0	N.	...do....	....	20	40	4,300	+ .1	14
19	9.20	e	Off Horn Point, bed No. 43.	10	...do..	0	N.	...do....	....	20	290	18,200	+ .1	32
22	3.15 p. m.	a	On point and above cove where city hospital sewer enters.	6	...do..	0	N.	...do....	....	23.8	250	2,700	+ .01	14
	3.30	b	Cove opposite where city hospital sewer enters.	10	...do..	0	N.	...do....	....	23.8	430	5,900	+ .01	41

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[1] Collected by the Department of Agriculture and examined by the Hygienic Laboratory, Public Health Service.

Table showing results of examinations of individual samples of shellfish and waters of Chesapeake Bay—Continued.

Date.	Hour.	Number.	Location at which sample was taken.	Depth.	Tide.	Turbidity.	Wind.	Weather.	Salinometer reading.	Temperature.	Colonies per cubic centimeter.		Smallest quantity of water from over bed in which *B. coli* was present.	Score based on *B. coli* in shell liquor.
											From water over bed in agar for 24 hours, at 37° C.	From shell liquor in agar for 72 hours, at 20° C.		
			MISCELLANEOUS SERIES—continued.											
			Severn River—Continued.	*Feet.*						°*C.*			*C. c.*	
1914. Sept. 22	3.45	c	Oyster bed below cove in which hospital sewer empties.	12	Ebb...	0	N.	Clear....	....	23.8	180	2,000	+ .1	41
			South River, Md.:											
June 25	11.45 a. m.	a	Bridge at head of South River.	12	...do..	0	NW.	...do....	....	....	43	7,500	+10	1
	12.15 p. m.	b	Cedar Point bar at black buoy.	15	...do..	0	NW.	...do....	....	....	9	850	−10	0
	12.45	c	Selby Bay opposite red buoy.	12	...do..	0	SE.	...do....	....	....	[2] 45 [2] 62	1,150	+10 +10	0
	1.15	d	Mouth of, between red and black buoys.	12	Flood.	0	SE.	....	....	....	....	400	....	2
Sept. 14	12.15	a	100 yards below Edgewater Bridge.	8	Ebb...	0	NE.	Clear....	....	21.0	60	2,[illegible]00	−10	4
	12.40	b	Ferry Point below mouth of Church Creek.	14	...do..	0	NE.	...do....	....	21.0	30	2,400	+10	3
	12.55	c	Back of black buoy off Cedar Point.	18	...do..	0	NE.	...do....	....	21.0	45	7,700	−10	1
	1.05	d	Below Persimmon Point.	12	...do..	0	NE.	...do....	....	21.0	47	13,700	+10	1
	1.20	e	Mouth of Selby Bay below Mayo Point.	8	...do..	0	NE.	...do....	....	21.0	193	8,200	+ 1	[4] 14
									Cl. p. p. m.					
Feb. 3	9.40 a. m.	[1] 18934	Off triangle 76, A. A. Co., Edgewater Branch.	18	Flood.	3	....	....	7,200	5.4	10	....	−10	....
	9.55	[1] 18935	Off triangle 74, A. A. Co., Perry Point.	15	...do..	3	....	....	7,150	5.2	21	....	−10	....
	10.15	[1] 18936	Off triangle 72, A. A. Co., Persimmon Point	6	...do..	3	....	....	6,650	4.4	35	....	−10	....

	10.30	[1] 18938	Off triangle 71, A. A. Co., Hill and Mayo Points.	18	...do..	5	....	....	7,200	5.0	28	....	−10	....
	10.55	[1] 18941	Off triangle 70, A. A. Co., Marshy Point.	15	...do..	5	....	....	5,550	3.6	32	....	−10	....
	10.15	[1] 18936	Bed 55, A. A. Co., Thunder and Lightning Point.	6	...do..	3	....	....	6,650	4.4	35	2,740	−10	410
	10.20	[1] 18937	Bed 62, A. A. Co., Purdy Flat.	7	...do..	3	....	....	5,950	4.6	41	500	−10	14
	10.45	[1] 18939	Bed 51, A. A. Co., Swan Reef.	6	...do..	3	....	....	5,150	3.8	42	2,100	−10	32
	10.50	[1] 18940	Bed 67, A. A. Co., Marshy Point.	12	...do..	3	....	....	4,850	4.0	23	67,000	+ 1	50
	11.25	[1] 18943	Bed 48, A. A. Co., south of Thomas Point.	20	...do..	3	....	....	5,600	....	48	1,060	+10	23
	11.10	[1] 18942	Bed 69, A. A. Co., off Saunders Point.	9	...do..	3	....	....	5,450	....	70	2,600	−10	23
			Rhode River:											
June 25	2.45 p. m.	f	At point below High Island.	10	Ebb...	0	SE.	Clear....	....	24.5	30	2,750	−10	1
Sept. 15	8.25 a. m.	c	On bar opposite Cadle Creek.	8	...do..	0	NE.	...do....	....	18.0	14	300	+10	3
	8.45	d	Mouth of Cadle Creek.	10	...do..	0	NE.	...do....	....	18.0	13	900	−10	5
	9.00	e	At mouth opposite Dutchman's Point.	10	...do..	0	NE.	...do....	....	18.0	10	400	−10	0
Feb. 4	11.00	[1] 18946	Triangle 91, A. A. Co., off Cadle Creek.	9	Flood.	2	....	....	6,400	6.4	19	....	+10	....
	10.45	[1] 18945	Bed 72, A. A. Co., above Dutchman's Point.	7	...do..	2	....	....	6,000	5.8	18	13,600	− 1	14
			West River:											
	11.30	[1] 18948	Bed 83, A. A. Co., between Galesville and Cedar Point.	4	...do..	2	....	....	6,050	5.8	45	....	−10	....
	11.15	[1] 18947	Bed 81, A. A. Co., off Cheston Point.	12	...do..	2	....	....	5,800	5.4	25	5,100	+10	50
	10.25	[1] 18944	Bed 70, A. A. Co., off Dutchman's Point.	12	...do..	3	....	....	5,400	4.8	44	6,000	−10	14
	11.55	[1] 18949	Bed 87, A. A. Co., off Three Sisters.	14	...do..	5	....	....	4,100	4.9	64	1,320	+10	5
June 25	2.15 p. m.	e	At Galloway Point....	12	...do..	0	SE.	Clear....	....	....	67	1,350	+10	3
	3.30	g	Red and black striped buoy at entrance.	20	...do..	0	SE.	...do....	....	24.5	13	4,650	+10	23
Sept. 15	7.25 a. m.	a	100 yards below Galesville, mouth of Tent House Creek.	10	...do..	0	NE.	...do....	....	18.0	88	1,300	+ 1	3
	8.00	b	On bar off Cedar Point.	12	...do..	0	NE.	...do....	....	18.0	15	200	−10	4

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[1] Collected by the Department of Agriculture and examined by the Hygienic Laboratory, Public Health Service.

[2] Surface.

[3] Deep.

[4] Bay drains a slough from farm land.

Table showing results of examinations of individual samples of shellfish and waters of Chesapeake Bay—Continued.

Date.	Hour.	Number.	Location at which sample was taken.	Depth.	Tide.	Turbidity.	Wind.	Weather.	Salinometer reading.	Temperature.	Colonies per cubic centimeter.		Smallest quantity of water from over bed in which *B. coli* was present.	Score based on *B. coli* in shell liquor.
											From water over bed in agar for 24 hours, at 37° C.	From shell liquor in agar for 72 hours, at 20° C.		
			MISCELLANEOUS SERIES—continued.											
1914.			Patuxent River, Md.:	*Feet.*					*Cl. p. p. m.*	*° C.*			*C. c.*	
Jan. 30	11.40 a. m.	[1] 18906	Off Point Judith......	6	Ebb...	35	....	....	5,850	7.2	70	....	+ 1	....
	11.10	[1] 18905	Off Long Point........	36	...do..	20	....	....	6,750	5.8	96	....	−10	....
	10.45	[1] 18904	Off Sheridan Point....	9	...do..	20	....	....	7,100	6.6	33	....	−10	....
	10.15	[1] 18903	Off Jack Bay..........	18	...do..	8	....	....	8,250	5.2	26	....	−10	....
	9.45	[1] 18902	Off Broome Island, triangle 36, Calvert Co.	48	...do..	5	....	....	8,250	5.2	47	....	−10	....
	9.15	[1] 18901	Above Sotterly Point, triangle 11, St. Marys Co.	45	...do..	5	....	....	8,700	5.2	19	....	−10	....
	4.00 p. m.	[1] 18911	Off Half-Pone Point, bed 14, St. Marys Co.	72	Flood.	0	....	....	9,000	4.8	40	....	−10	....
	4.45	[1] 18913	Off Solomons Island, triangle 22, Calvert Co.	39	...do..	0	....	....	8,900	5.8	18	....	+ 1	....
	5.00	[1] 18914	1 mile above Drum Point Light.	36	...do..	0	....	....	9,000	4.8	10	....	−10	....
	5.15	[1] 18915	1 mile below Drum Point Light.	39	...do..	5	....	....	9,060	4.8	6	....	−10	....
Mar. 10	6.50	[1] 20504	Off Point Judith......	6	Ebb...	50	....	....	5,550	1.8	120	....	−10	....
	6.30	[1] 20503	Off Long Point........	36	...do..	15	....	....	5,600	1.8	39	....	−10	....
	6.00	[1] 20502	Off Sheridan Point....	9	...do..	15	....	....	6,600	1.8	25	....	+10	....
	5.30	[1] 20501	Off Jack Bay..........	18	...do..	2	....	....	7,200	1.8	19	....	+10	....
	4.30	[1] 18999	Off Broome Island Point, triangle 36, Calvert Co.	48	...do..	2	....	....	7,150	1.6	10	....	−10	....
	4.35	[1] 18998	Above Sotterly Point, triangle 11, St. Marys Co.	45	...do..	2	....	....	7,300	1.8	29	....	−10	....
	3.50	[1] 18997	Off Half-Pone Point, bed 14, St. Marys Co.	72	...do..	2	....	....	7,550	1.6	16	....	+10	....
	3.10	[1] 18995	Off Solomons Island, triangle 22, Calvert Co.	39	...do..	0	....	....	7,900	1.2	27	....	+10	....
	2.50	[1] 18994	1 mile above Drum Point Light.	48	...do..	0	....	....	7,950	1.4	68	....	−10	....
	2.30	[1] 18993	1 mile below Drum Point Light.	39	...do..	10	....	....	8,000	1.4	7	....	−10	....

Jan. 30	11.40 a. m.	[1] 18906	Off Point Judith......	6	...do..	35	....	....	5,850	7.2	70	8,200	+ 1	5
	1.15 p. m.	[1] 18907	Between Benedick and Mills Creek, bed 3, Charles Co.	6	Flood.	0	....	....	6,300	9.8	44	156,000	− .1	41
	1.50	[1] 18908	Mouth of Persimmon Creek, bed 3, St. Marys Co.	6	...do..	2	....	....	7,300	7.0	37	18,000	−10	32
	2.35	[1] 18909	Mouth of Battle Creek, bed 33, Calvert Co.	14	...do..	2	....	....	7,500	7.0	24	10,200	− 1	4
	2.00	[1] 18910	Off Parkers Wharf, bed 31, Calvert Co.	12	...do..	2	....	....	7,950	6.6	18	8,500	−10	1,400
	4.15	[1] 18912	Mouth of Cuckold Creek, bed 14, St. Marys Co.	20	...do..	2	....	....	8,600	6.2	64	500,000	−10	140
	4.45	[1] 18913	Off Solomons Island, bed 22, Calvert Co.	39	...do..	3	....	....	8,950	5.8	18	105,000	+ 1	14
Mar. 10	5.10	[1] 19000	Off Parkers Wharf, bed 31, Calvert Co.	12	Ebb...	1	....	....	7,100	1.6	19	600	+10	0
	3.45	[1] 18996	Mouth of Cuckold Creek, bed 14, St. Marys Co.	22	...do..	2	....	....	7,550	1.6	15	400	−10	0
	3.10	[1] 18995	Off Solomons Island, triangle 22, Calvert Co.	39	...do..	0	....	....	7,900	1.2	27	500	+10	0
	2.50	[1] 18994	1 mile above Drum Point Light.	48	...do..	3	....	....	7,950	1.4	68	250	−10	2
Sept. 11	11.10 a. m.	a	Below pile on right of entrance to Solomons Island.	8	...do..	0	NW.	Fair....	....	23.5	27	1,500	+10	4
	11.30	b	800 yards off mouth Town Creek.	24	...do..	0	NW.	...do....	....	23.5	10	3,900	−10	3
	11.50	c	Back of black buoy off Long Pone Point.	12	...do..	0	NW.	...do....	....	23.5	8	1,100	+10	5
	12.20 p. m.	d	Back of red buoy, Helens Creek.	18	...do..	0	NW.	...do....	....	23.5	11	450	−10	0
	12.45	e	200 yards above red beacon off Petersons Point.	18	...do..	0	NW.	...do....	....	23.5	14	400	−10	2
	1.10	f	Off mouth of creek below Broome Island.	18	...do..	0	NW.	...do....	....	23.5	4	2,100	+ 1	0
	1.45	g	Halfway between Williams Wharf and red buoy on point below.	14	Flood.	0	NW.	...do....	....	23.5	14	300	+10	0
	2.20	h	Black buoy opposite Sheridans Point.	12	...do..	0	NW.	...do....	....	23.5	108	500	−10	0
	3.00	i	Black buoy off Town Point.	8	...do..	0	NW.	...do....	....	23.5	60	2,100	−10	1
	5.10	j	Middle ground, off Solomons Island.	10	...do..	0	SW.	Cloudy..	....	23.5	26	2,800	+10	14

[1] Collected by the Department of Agriculture and examined by the Hygienic Laboratory, Public Health Service.

Table showing results of examinations of individual samples of shellfish and waters of Chesapeake Bay—Continued.

Date.	Hour.	Number.	Location at which sample was taken.	Depth.	Tide.	Turbidity.	Wind.	Weather.	Salinometer reading.	Temperature.	Colonies per cubic centimeter.		Smallest quantity of water from over bed in which *B. coli* was present.	Score based on *B. coli* in shell liquor.
											From water over bed in agar for 24 hours, at 37° C.	From shell liquor in agar for 72 hours, at 20° C.		
			MISCELLANEOUS SERIES—continued.											
			Great Wicomico River, Virginia:	*Feet.*					*Cl. p. p. m.*	°*C.*			*C. c.*	
1915. June 9	1.45 p. m.	a	200 yards above beacon at mouth of Cockrells Creek.	20	Ebb...	0	....	Clear....	....	22.5	12	5,100	−10	4
	1.55	b	200 yards below beacon at mouth of Cockrells Creek.	22	...do...	0	....	...do....	....	22.5	9	7,100	−10	2
	2.15	c	Fleet Point, on side of channel opposite beacon.	22	...do...	0	....	...do....	....	22.5	....	2,700	....	0
	2.30	d	Left side channel, opposite mouth of Cockrells Creek.	24	...do...	0	....	...do....	....	22.5	35	6,900	+ 1	1
	2.45	e	Dodsons Flat below mouth of Whays Creek.	12	...do...	0	....	...do....	....	22.5	140	15,000	+10	23
	3.00	f	800 yards above mouth of Whays Creek.	12	...do...	0	....	...do....	....	22.5	160	12,000	+ 1	3
	3.15	g	Sandy Point, 200 yards from shore, above black beacon.	18	...do...	0	....	...do....	....	22.5	180	12,000	+ 1	3
	3.45	h	500 yards below Seaboard Guano & Oil Co. fish factory.	12	...do...	0	....	...do....	....	22.5	235	7,300	+ .1	3
	3.55	i	500 yards below Milo Wharf.	12	...do...	0	....	...do....	....	22.5	98	4,100	−10	4
	4.15	j	Point 200 yards below Blackwells Wharf.	12	...do...	0	....	...do....	....	22.5	88	2,300	+ 1	1
	5.00	k	800 yards below Sampsons Wharf.	18	...do...	0	....	...do....	....	22.5	22	500	−10	1
10	9.10 a. m.	a	Cockrells Creek—Reedville Wharf..	2	Flood.	0	....	...do....	....	22	3,000	....	− .1	....
	9.14	1	Off upper fish factory.	4	...do...	0	....	...do....	....	22	500	....	− .1	....
	9.16	2	Off second fish factory.	4	...do...	0	....	...do....	....	22	9,400	....	+ .1	....

	9.20	3	Off fourth fish factory.	4	...do...	0	....	..do....	....	22	2,700	....	+ .001	....
	9.25	4	Above Fleeton Wharf.	4	...do...	0	....	..do....	....	22	1,500	....	+ .1	....
	9.30	5	Mouth of creek off Fleet Point.	4	..do...	0	....	..do....	....	22	420	....	+ 1	....
			Rappahannock River, Virginia:											
1914. Mar. 19	10 a. m.	a	Off Smoky Point.....	10	Ebb...	0	W.	...do.....	6,750	7	44	550	− 1	0
	12 m.	b	Belle Isle below Wheaton.	18	...do...	0	W.	...do.....	5,796	7	43	750	− 1	0
	2 p. m.	c	Off Deep Creek ¾ mile above Manasquan Wharf, 700 yards off shore.	15	...do...	0	W.	...do.....	....	7	....	1,130	....	0
	3	d	100 yards below Sharps Wharf.	10	...do...	....	W.	...do.....	....	7	....	7,750	....	3
	4	e	100 yards below Tolls Point.	12	Flood.	....	SE.	Cloudy	8,649	6	27	240	− 1	2
	4.35	f	Off Millenbeck Wharf, mouth of Corotoman Creek.	18	...do...	....	SE.	...do.....	....	6	....	1,400	....	0
	2	g	Off Deep Creek, 100 yards below entrance.	12	Slack..	....	SW.	Fair.....	7,020	7	95	610	− 1	0
	12.30	h	Moradica Bar.........	12	Ebb...	....	W.	Clear....	[1] 4,914 [2] 5,922	7 7	[1] 40 [2] 235	30,000	− 1	0
	5.30	i	Urbanna Creek at Jim Burton's landing a few feet from privy.	6	Flood.	....	NW.	Fair.....	....	7	....	960	....	5
	12.30	j	200 yards above Sharps Wharf.	12	Ebb...	....	NW.	...do.....	3,675	7	75	10,000	− 1	0
	10 a. m.	k	Off Bowlers Wharf....	12	...do...	....	NW.	...do.....	2,130	7	95	7,800	− 1	0
	1 p. m.	l	Off Punch Bowl, South side of channel.	12	...do...	....	NW.	...do.....	5,795 6,120	7	[1] 35 [2] 42	475	− 1	0
	....	....	Sample of shell liquor from can ready for shipment, packing house of Dameron Bros., Irvington (Weems).	....	....	....	....	....	....	....	....	(3)	+ .1	....
20	6.45 a. m.	a	Off ice wharf at Urbanna.	2	Flood.	0	NW.	Fair.....	8,073	7	160	....	− 1	....
	7.00	b	Urbanna Creek at mouth.	2	...do...	0	NW.	...do.....	8,331	7	70	....	− 1	....
	10.30	c	Abreast Tappahannock Wharf in channel.	2	Ebb...	500	NW.	...do.....	840	7	250	....	− 1	....

[1] Surface.

[2] Deep.

[3] Overgrown in .01.

Table showing results of examinations of individual samples of shellfish and waters of Chesapeake Bay—Continued.

Date.	Hour.	Number.	Location at which sample was taken.	Depth.	Tide.	Turbidity.	Wind.	Weather.	Salinometer reading.	Temperature.	Colonies per cubic centimeter.		Smallest quantity of water from over bed in which *B. coli* was present.	Score based on *B. coli* in shell liquor.
											From water over bed in agar for 24 hours, at 37° C.	From shell liquor in agar for 72 hours, at 20° C.		
			MISCELLANEOUS SERIES—continued.											
			Rappahannock River, Virginia—Continued.	*Feet.*					*Cl. p. p. m.*	*°C.*			*C. c.*	
1914. Mar 20	11.00 a. m.	d	Abreast Black Can buoy below Tappahannock Wharf in channel.	2	Ebb...	150	NW.	Fair	1,095	7	235	....	+ 1	....
	11.15	e	Between Ware and Wellfords Wharf, in channel.	2	...do...	90	NW.	...do.....	2,040	7	85	....	− 1	....
	11.30	f	Opposite Eubanks Wharf in channel.	2	...do...	90	NW.	...do.....	2,286	6.75	110	....	+ 1	....
	11.55	g	Above Bowlers Rock, in channel.	2	...do...	80	NW.	...do.....	2,754	6.75	....	....	− 1	....
June 10	2.00 p. m.	a	200 yards off Sharps Wharf.	12	Flood.	0	....	Clear....	....	25	54	39,000	+10	4
	2.10	b	Opposite side channel from Sharps Wharf.	10	...do...	....	....	...do.....	....	25	65	23 000	+ 1	3
	2.30	c	Farnham Creek, 200 yards off mouth.	12	...do...	0	....	...do.....	....	25	52	6,500	+10	2
	2.55	d	Between Jones Point and Bay Port Wharf, 200 yards off shore.	12	...do...	0	....	...do.....	....	25	39	3,500	+10	2
	3.15	e	500 yards off Lancaster Creek.	18	Ebb...	0	....	...do.....	....	25	38	2,200	+ 1	3
	3.30	f	500 yards below Whealton Wharf.	18	...do...	0	....	...do.....	....	25	32	2,500	+10	0
	3.50	g	200 yards off mouth of Deep Creek.	14	...do...	0	....	...do.....	....	25	30	14,500	+10	5
	4.30	h	Off Punch Bowl, above Water View Wharf.	18	...do...	0	....	...do.....	....	25	40	2,200	−10	0
	5.10	i	100 yards off mouth of Weeks Creek.	8	...do...	0	....	...do.....	....	25	20	6,000	+10	3
	5.50	j	Just above Rogues Point.	18	...do...	0	....	...do.....	....	25	28	2,100	−10	4

11	7.45 a. m.	a	Urbanna Creek— Jim Burton's oyster wharf.	6	Flood.	0	....	...do...	....	25	2,100	1,200	+ .01	5
	8.30	b	Above bridge, off yellow bungalow.	4	...do...	0	....	...do...	....	25	....	900	....	4
	8.45	c	From shore opposite to yellow bungalow.	4	...do...	0	....	...do...	....	25	....	2,300	....	2
	9.00	d	Opposite shore from sewer outlet.	4	...do...	0	....	...do...	....	25	....	1,100	....	1
	9.15	e	Above ferry house, opposite town.	4	...do...	0	....	...do...	....	25	150	100	+ 1	1
	9.30	f	Below ferry house, opposite town.	4	...do...	0	....	...do...	....	25	190	20,000	+ 1	2
	10.00	g	Above Grossetts Wharf.	4	...do...	0	....	...do...	....	25	90	11,000	+ 1	0
	7.45	j	On shoal back of sewer outlet off railway.	4	...do...	0	....	...do...	....	25	....	1,900	....	32
	12.15 p. m.	i	Corotoman Creek, off entrance (Orchard Point).	18	...do...	0	....	...do...	....	25	....	600	....	2
	11.30 a. m.	h	Above Tolls Point....	9	...do...	0	....	...do...	....	25	26	1,200	−10	3
	8.45	b	Urbanna Creek— Draw of Highway Bridge.	2	...do...	0	....	...do...	....	25	280	....	+ 1	....
	9.00	c	Over sewer outlet.	2	...do...	0	....	...do...	....	25	370	....	+ .01	....
12	8.00	a	Carters Creek, Va.— Point 200 yards above Irvington Wharf.	2	Ebb..	0	....	...do...	....	27	70	260,000	+ 1	2
	8.05	b	In cove opposite Irvington Wharf.	2	...do...	0	....	...do...	....	27	90	300,000	− 1	5
	8.15	c	On point opposite Irvington Wharf.	3	...do...	0	....	...do...	....	27	200	600,000	+ 1	4
	8.20	d	On point in arm of creek below Irvington Wharf.	2	...do...	0	....	...do...	....	27	110	300,000	− 1	5
	8.35	e	In cove below, and opposite arm of creek where sample "d" was taken.	3	...do...	0	....	...do...	....	27	440	19,000	− 1	0
	8.45	f	In cove below and opposite sample "e."	3	...do...	0	....	...do...	....	27	110	800,000	− 1	23
	8.50	g	On Point above new railway.	2	...do...	0	....	...do...	....	27	170	600,000	+ .1	5
	9.40	h	Head of church prong.	3	...do...	0	....	...do...	....	27	60	35,000	− 1	3

Table showing results of examinations of individual samples of shellfish and waters of Chesapeake Bay—Continued.

Date.	Hour.	Number.	Location at which sample was taken.	Depth.	Tide.	Turbidity.	Wind.	Weather.	Salinometer reading.	Temperature.	Colonies per cubic centimeter.		Smallest quantity of water from over bed in which *B. coli* was present.	Score based on *B. coli* in shell liquor.
											From water over bed in agar for 24 hours, at 37° C.	From shell liquor in agar for 72 hours, at 20° C.		
			MISCELLANEOUS SERIES—continued.											
			Rappahannock River, Virginia—Continued.											
			Carters Creek, Va.—Continued.	*Feet.*					*Cl.p.p.m.*	°*C.*			*C. c.*	
1914. June 12	9.50 a. m.	i	Church prong, frame house on point, 500 yards below head.	2	Flood.	0	....	Clear....	....	27	140	42,000	− 1	5
	9.55	j	Cove back of white-washed house.	2	...do...	0	....	...do.....	....	27	900	800,000	+ .1	3
	10.00	k	On point off white-washed bungalow.	2	...do...	0	....	...do.....	....	27	220	800,000	− 1	3
	10.05	l	In cove above fish factory.	2	...do...	0	....	...do.....	....	27	580	60,000	− 1	4
	10.20	m	On point opposite fish factory.	2	Flood.	0	....	...do.....	....	27	1,790	120,000	+ 1	3
	10.25	n	Back of John Eck Point.	4	...do...	0	....	...do.....	....	27	1,980	220,000	− 1	5
	10.35	o	Above Humphrey's marine railway.	4	...do...	0	....	...do.....	....	27	130	120,000	− 1	4
	10.40	p	On point opposite and above railway.	2	...do...	0	....	...do.....	....	27	320	350,000	+ 1	4
	10.50	r	At mouth of small creek below railway.	2	...do...	0	....	...do.....	....	27	1,360	60,000	+ .1	3
	11.15	s	Left side of entrance to Carters Creek.	8	...do...	0	....	...do.....	....	27	335	500,000	−10	4
	11.25	t	Right side of entrance to Carters Creek.	10	...do...	0	....	...do.....	....	27	355	80,000	+ 1	5

			Piankatank River, Va.:											
	2.35 p. m.	a	100 yards above Jacksons Wharf.	10	...do...	0	....	...do.....	....	25	....	1,400	....	3
	2.45	b	Flat 100 yards below Jacksons Wharf.	4	...do...	0	....	...do.....	....	25	....	2,800	....	1
	3.35	c	Off entrance to Queens Creek.	12	...do...	0	....	...do.....	....	25	....	900	....	1
	4.00	d	Milford Haven, Callis Wharf.	14	...do...	0	....	...do.....	....	25	....	1,700	....	4
	4.30	e	Milford Haven, Cockrells Point.	16	...do...	0	....	...do.....	....	25	....	700	....	2
16	8.00 a. m.	f	Fishing Cove, Ruarks Wharf.	10	Ebb...	0	....	...do.....	....	24.5	....	7,500	....	0
	8.25	g	On bar off Roan Point.	8	...do...	0	NW.	...do.....	....	24.5	....	2,750	....	4
	8.55	h	On bar off mouth Cobbs Creek, Ginneys Point.	10	...do...	0	NW.	...do.....	....	24.5	....	3,700	....	0
	9.45	i	South shore of Berkley Island.	10	...do...	0	NW.	...do.....	....	24.5	....	5,250	....	1
	10.15	j	Cove below Freeport..	12	...do...	0	NW.	...do.....	....	24.5	....	2,500	....	[illegible]
			Mobjack Bay:											
			Mattaponi River—						Salinometer.					
1915. Feb. 2	8.30	1	Opposite side river from Standard Oil tank.	8	Flood.	50	NW.	Cloudy..	1.0050	6	230	3,600	+10	0
	8.45	2	Opposite side river from Marshall's oyster house.	8	...do...	50	NW.	...do.....	1.0050	6	320	13,800	+ 1	3
	11.00	3*	250 yards NE. of Marshall's oyster house.	30	...do...	50	NW.	...do.....	1.0073	6	130	12,700	+10	1
			York River—											
	11.20	4	Below Goffs Point, lower end of jetty, bed of Geo. Richardson.	15	...do...	50	NW.	...do.....	1.0100	6	122	80,000	+10	1
	11.40	5	Inshore of and above Bell Rock Lighthouse.	8	...do...	50	NW.	...do.....	1.0105	6	98	16,800	−10	0
	12.30 p. m.	6	Mouth of Poropotank Creek 300 yards NW. of West End Wharf.	6	...do...	50	NW.	...do.....	1.0105	6	46	5,800	−10	0
	1.30	7	300 yards above wharf at Almondsville.	6	...do...	25	NW.	...do.....	1.0135	5.5	38	6,600	+10	0
	2.15	8	Pages Rock Lighthouse, mouth of Carters Creek.	6	...do...	5	NW.	...do.....	1.0160	5.5	27	10,400	−10	0

Table showing results of examinations of individual samples of shellfish and waters of Chesapeake Bay—Continued

Date.	Hour.	Number.	Location at which sample was taken.	Depth.	Tide.	Turbidity.	Wind.	Weather.	Salinometer reading.	Temperature.	Colonies per cubic centimeter.		Smallest quantity of water from over bed in which *B. coli* was present.	Score based on *B. coli* in shell liquor.
											From water over bed in agar for 24 hours, at 37° C.	From shell liquor in agar for 72 hours, at 20° C.		
			MISCELLANEOUS SERIES—continued.											
			Mobjack Bay—Contd.											
			York River—Contd.	*Feet.*					*Salinometer.*	°*C.*			*C. c.*	
1915. Feb. 2	2.45 p. m.	9	Near mouth of Timber Neck Creek above Carmines Wharf.	6	Flood.	5	NW.	Clear....	1.0160	5.5	21	19,000	+10	1
	3.00	10	Just below Gloucester Point, mouth Sarahs Creek.	6	...do...	5	NW.	...do.....	1.0160	5.5	78	150,000	+10	2
			Poquoson River—											
3	8.30 a. m.	11	Middle of river, 300 yards off Hunts Wharf.	12	...do...	5	NE.	Foggy...	1.0150	6.7	71	1,600	+ 1	0
	9.10	12	200 yards above Messicks Point.	2	...do...	5	NE.	...do.....	1.0150	6.7	145	12,700	+ 1	32
	9.35	13	In front of Hopkins House.	12	...do...	5	NE.	...do.....	1.0125	7.2	116	10,400	+ 1	4
	9.45	14	Opposite Mrs. Wainwright's house, 100 feet offshore.	5	...do...	5	NE.	...do.....	1.0125	7.2	104	8,400	+ 1	4
	10.00	15	Cheesmans Creek near Foster House.	8	...do...	5	NE.	...do.....	1.0125	7.2	104	2.000	+ 1	4
	10.45	16	Cheesmans Creek near shipyard.	8	...do...	5	NE.	...do.....	1.0140	6.1	117	4,200	+ 1	5
	5.00 p. m.	17	Shore end of Wainwrights Dock.	2	...do...	5	NE.	...do.....	1.0140	....	....	17.000	....	2
			East River, Va.—											
4	11.30 a. m.	18	200 yards off Dr. Jordan's.	6	...do..	0	NW.	Snow...	1.0140	3.9	65	4,000	+ 1	0
	11.40	19	300 feet off Long Point.	10	...do..	0	NW.	...do....	1.0145	3.5	83	2,300	+ 1	3

12.00 m.	20	Puttin Creek, mouth of prong leading to Mathews Court House.	8	...do..	0	NW.	...do....	1.0135	3.3	135	12,500	+ 1	4
12.05 p. m.	21	Puttin Creek, 150 feet off Frank James's residence.	8	...do..	0	NW.	...do..	1.0135	3.3	116	4,200	+ 1	23
12.20	22	300 feet offshore, 200 yards below Hicks's Wharf.	....	...do..	0	NW.	...do....	1.0155	4.5	33	4,400	+ 1	14
12.20	23	250 yards below Williams's Wharf.	10	...do..	0	NW.	...do....	1.0155	4.5	74	1,700	+ 1	3
12.40	24	100 yards off Henry Foster's residence.	10	Ebb...	0	NW.	...do....	1.0155	4.5	44	2,100	+10	3
1.00	25	300 yards above Philpotts's Wharf, 150 yards offshore.	12	...do..	....	NW.	...do....	1.0155	4.5	65	2,000	+10	1
		North River, Va.—											
2.15	26	Capt. Nelson's bed	6	...do..	0	SE.	Cloudy..	1.0150	4.5	20	2,400	+10	0
2.20	27	Do............	6	...do..	0	SE.	...do....	1.0150	4.5	38	3,200	+10	1
2.30	28	Hicks's bed, opposite and above Dixondale.	10	...do..	0	SE.	...do....	1.0150	4.5	34	2,200	+10	4
2.40	29	Below Perceval Hicks, near shore.	10	...do..	0	SE.	...do....	1.0150	4.5	....	1,000	....	0
2.45	30	In front of Tabb place, 200 feet offshore.	12	...do..	0	SE.	...do....	1.0150	4.5	25	1,200	−10	1
2.50	31	In front of "Bellville."	12	...do..	0	SE.	...do....	1.0150	4.5	18	6,200	−10	2
3.00	32	Mouth of creek below Bellville.	12	...do..	0	SE.	...do....	1.0150	4.5	31	10,400	+ 1	3
3.15	33	Above beacon on Lone Point.	12	...do..	0	SE.	...do....	1.0155	5.5	29	1,300	−10	4
4.15	34	James Bros.' beds off black beacon (Mobjack Bay).	10	...do..	0	SE.	...do.....	1.0155	5.5	18	19,000	+10	23
4.00	35	300 yards off Dunhamassie, below Dixondale bed of Geo. Taliaferro.	15	...do..	0	SE.	...do....	1.0155	5.5	....	10,200	....	14

Table showing results of examinations of individual samples of shellfish and waters of Chesapeake Bay—Continued.

Date.	Hour.	Number.	Location at which sample was taken.	Depth.	Tide.	Turbidity.	Wind.	Weather.	Salinometer reading.	Temperature.	Colonies per cubic centimeter.		Smallest quantity of water from over bed in which *B. coli* was present.	Score based on *B. coli* in shell liquor.
											From water over bed in agar for 24 hours, at 37° C.	From shell liquor in agar for 72 hours, at 20° C.		
			MISCELLANEOUS SERIES—continued.											
			Mobjack Bay—Contd.											
			Ware River—	*Feet.*					*Salinometer.*	*°C.*			*C. c.*	
1915. Feb. 6	8.50 a. m.	36	Mouth of Wilson's creek, 300 yards above Roan's wharf.	3	Flood.	0	SW.	Clear....	1.0150	5.5	16	1,100	−10	0
	9.10	37	250 yards below Bailey's wharf.	7	...do..	0	SW.	...do....	1.0150	5.5	78	5,900	+10	0
	9.15	38	Off R. C. Smith's residence.	3	...do..	0	SW.	...do....	1.0150	5.5	39	12,800	+ 1	0
	9.30	39	Jordan Bright's bed.	7	...do..	0	SW.	...do....	1.0110	6.1	44	5,600	+10	1
	9.50	40	Ware Landing, Smith's bed near head of river,	3	...do..	5	SW.	...do....	1.0080	6.6	52	5,800	+ 1	1
	10.10	41	On point opposite upper steamer wharf.	6	...do..	0	SW.	...do....	1.0140	6.1	32	3,200	−10	0
			Severn River—											
	11.50	42	West Prong, 100 feet offshore south of Cod Point.	2½	...do..	0	SW.	...do....	1.0135	7.2	76	3,300	+10	1
	12.00 m.	43	Opposite Bryans Point.	8	...do..	0	SW.	...do....	1.0140	7.2	70	5,200	+10	0
	12.15 p. m.	44	Mouth of South Prong.	12	...do..	0	SW.	...do....	1.0140	7.2	28	5,600	+10	0
	12.30	45	Mouth of South Prong, below wharf.	10	...do..	0	SW.	...do....	1.0150	7.2	30	5,100	+10	0
			Back River, Va.:											
1914. Nov. 23	1.05	32	300 yards E. of point SW. of Messick's Wharf, Darling's farm, on bed of Darling.	12	...do..	0	NW.	...do....	1.0200	6	9	2,300	−10	50

	1.20	33	South West Branch, 200 yards E. of F. Darling farm.	2	...do..	0	NW.	...do....	1.0200	5.8	11	2,400	−10	23
	2.00	34	North West Branch, opposite Kimberley.	8–10	...do..	0	NW.	...do....	1.0200	5.5	....	6,900	−10	32
	2.40	35	School Neck, head of branch, Forest bed.	3	...do..	0	NW.	...do....	1.0200	5.5	....	3,600	−10	2
Dec. 19	2.40	1	Near black spar buoy, off Harrisons Creek.	12	Ebb...	0	NW.	Cloudy..	1.0170	3.3	24	200	+ 1	[2] 0
	3.00	2	South West Branch— 300 yards SE. "Mill Farm," off Latimers.	2	...do..	0	NW.	...do....	1.0150	3.3	83	2,200	+10	4
	3.35	3	300 yards off and above Normal School farm pier, half way between Sherwood and Mill Farm.	[1] 18	...do..	0	NW.	Rain....	1.0150	3.3	46	2,300	+10	5
	3.45	4	300 yards off Normal School farm, 300 yards off Sherwood House.	2	...do..	0	NW.	...do....	1.0160	3.3	53	1,700	+10	5
	4.00	5	400 yards above Willoughby Point.	2	...do..	0	NW.	...do..	1.0160	2.8	31	1,700	−10	14
	4.15	6	400 yards off Kimberley's "Lamington."	4	...do..	0	NE.	...do....	1.0170	2.8	28	500	−10	3
	4.30	7	North West Branch, off Shields Point.	3	...do..	0	NE.	...do....	1.0165	3.3	34	1,900	−10	14
	4.45	8	North edge of channel half way between Messick's and Amory's wharf.	6	...do..	0	NE.	...do....	1.0170	3.3	37	1,700	−10	14
			James River, Va.: Brown Shoals—											
Nov. 25	8.40 a. m.	1	1,000 yards offshore, 1 mile above shipyard.	5	...do..	0	SW.	Clear....	1.0160	6.6	3	800	−10	4
	9.00	2	500 yards above 1.	8	...do..	0	SW.	...do....	1.0160	6.6	5	400	−10	32
	9.10	3	800 to 900 yards offshore, 1,500 yards above shipyard.	8	...do..	0	SW.	...do....	1.0160	6.6	6	900	+10	14
	9.15	4	400 yards offshore, last residence on front.	5	...do..	0	SW.	...do....	1.0160	6.6	3	2,500	−10	5
	9.30	5	Upper end of shoals.	4	...do..	0	SW.	...do....	1.0160	6.9	5	5,200	−10	32

[1] Inches.

[2] Clams.

Table showing results of examinations of individual samples of shellfish and waters of Chesapeake Bay—Continued.

Date.	Hour.	Number.	Location at which sample was taken.	Depth.	Tide.	Turbidity.	Wind.	Weather.	Salinometer reading.	Temperature.	Colonies per cubic centimeter.		Smallest quantity of water from over bed in which *B. coli* was present.	Score based on *B. coli* in shell liquor.
											From water over bed in agar for 24 hours, at 37° C.	From shell liquor in agar for 72 hours, at 20° C.		
			MISCELLANEOUS SERIES—continued.											
			James River, Va.—Contd.											
			Brown Shoals—Contd.	*Feet.*					*Salinometer.*	°*C.*			*C. c.*	
1914. Nov. 25	9.50 a. m.	6	50 yards above upper end of shoals.	6	Ebb..	0	SW.	...do....	1.0160	6.9	5	700	+10	1
	10.40	7	Middle of shoals...	6	..do..	0	SW.	...do....	1.0160	6.9	9	900	+10	2
	10.50	8	Outside of lower end of shoals.	8	...do..	0	SW.	...do....	1.0160	6.9	9	500	−10	3
	7.30	a	Hampton Bar off Ferry ship, 1,000 yards.	2	...do..	0	SW.	...do....	1.0190	6.9	10	....	−10	....
	7.50	b	Buxton Hospital, 1,000 yards.	2	...do..	0	SW	...do....	1.0190	6.9	6	....	+10	....
	7.55	c	Buxton Hospital N., Ivy Avenue Pier SW.	2	...do..	0	SW.	...do....	1.0190	6.9	7	....	+10	....
	7.58	d	200 yards off Buxton Hospital N., Ivy Avenue Pier SW.	2	...do..	0	SW.	...do....	1.0190	6.9	6	....	+ 1	....
	8.05	e	Small boat harbor.....	2	...do..	0	SW.	...do....	1.0190	6.9	10	....	+ 1	....
	8.10	f	Off C. & O. Pier 9.....	2	...do..	0	SW.	...do....	1.0190	6.9	10	....	+ 1	....
	8.20	g	Off Dry Dock No. 1...	2	...do..	0	SW.	...do....	1.0190	6.9	7	....	+ 1	....
Dec. 4	11.40	25	1 mile above shipyard, 800 yards from shore.	12	Flood.	0	NE.	Cloudy..	1.0185	10.5	7	1,400	+ 1	4
	11.55	26	500 yards above 25....	12	...do...	0	NE.	...do.....	1.0185	10.5	4	2,800	+10	5
	12.00	27	1,000 yards below end of Brown Shoal, 500 yards offshore.	10	...do...	0	NE.	...do.....	1.0185	10.5	9	700	+ 1	32
	1.00 p. m.	28	Off Blunt Point near shore.	10	...do...	0	NE.	...do.....	1.0170	10.5	11	6,000	+10	50
	1.05	29	Upper end of White shoal.	6	Ebb ..	0	NE.	...do.....	1.0175	10.5	....	60,000	....	23
	2.10	30	Abreast and 50 feet east of White Shoal Lighthouse.	10	...do...	0	NE.	...do.....	1.0175	10.5	20	1,400	+10	5

9	12.23	1	Brown Shoal, ½ mile off "Bowman" or Pembroke Jones house.	12	Flood.	0	NE.	...do.....	1.0170	8.9	7	1,300	+10	5
	12.32	2	Brown Shoal, Douglas Smiths house, N. White Shoal Light WNW., ½ mile offshore.	12	...do...	0	NW.	...do.....	1.0170	8.9	9	1,000	+10	5
	12.55	3	Lower Thomas Rock, White Shoal WSW., Blunts Point NW.	....	...do...	0	NW.	...do.....	1.0170	8.9	....	700	....	14
	1.00	4	Upper Thomas Rock, White Shoal WSW., Blunts Point SW.	10	...do...	0	NW.	...do.....	1.0170	8.9	8	6,200	+10	41
	1.05	5	Upper Thomas Rock, White Shoal WSW., Blunts Point NNW.	10	...do...	0	NW.	...do.....	1.0170	8.9	16	1,300	+10	5
	1.35	6	Off mouth of Warwick River 500 yards S. of Blunts Point.	8	...do...	0	NW.	...do.....	1.0165	8.9	14	9,900	+10	41
	1.45	7	Off mouth Warwick River, 800 yards off, Blunts Point WSW.	8	...do...	0	NW	...do.....	1.01525	8.9	11	11,600	+ 1	41
	2.00	8	White Shoal, edge of Shoal, 500 yards NW. of lighthouse.	10	...do...	0	NW.	...do.....	1.0160	8.9	10	19,000	+10	41
	2.15	9	White Shoal Light, edge of shoal, 500 yards SSE.	8	...do...	0	NW.	...do.....	1.0160	8.9	18	3,400	+ 1	41
	2.30	10	1 mile below White Shoal.	2	...do...	0	NW.	...do.....	1.0165	8.9	22	....	+10	....
	2.40	11	2 miles below White Shoal.	2	...do...	0	NW.	...do.....	1.0165	8.9	14	....	+10	....
	2.50	12	1 mile above shipyard upper pier.	2	...do...	0	NW.	...do.....	1.0175	8.9	30	....	+ 1	....
	2.50	13	400 yards off Warwick Park, Newport News.	2	...do...	0	NW.	...do.....	1.0165	8.9	38	....	+10	....
13	1.00 p. m.	1	Channel abreast White Shoals Lighthouse.	2	Ebb..	310	Gale east.	Rain....	1.0145	8.3	11	....	+10	....
	1.30	2	Channel abreast point of Shoals Lighthouse.	2	...do...	310	...do...	...do.....	1.0095	7.2	18	....	+10	....
	2.20	3	Deep Water Shoal Lighthouse.	2	...do...	310	...do...	...do.....	1.0090	7.2	50	....	− 1	....
	2.50	4	Abreast Hog Island...	2	...do...	310	...do...	...do.....	1.0055	7.2	180	....	+ 1	....
	3.15	5	Abreast Church Point, Jamestown Island.	2	...do...	300+	...do...	...do.....	....	7.2	70	....	− 1	....
	3.40	6	Abreast mouth Chickahominy River.	2	...do...	600+	...do...	...do.....	....	7.2	160	....	+ 1	....

Table showing results of examinations of individual samples of shellfish and waters of Chesapeake Bay—Continued.

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											From water over bed in agar for 24 hours, at 37° C.	From shell liquor in agar for 72 hours, at 20° C.		
			MISCELLANEOUS SERIES—continued.											
			James River, Va.—Contd.	*Feet.*					*Salinometer.*	*°C.*			*C. c.*	
1914. Dec. 14	4.15 p. m.	7	Abreast Claremont....	2	Ebb...	600+	Gale east.	Rain....	....	7.2	120	....	+ 1	....
	5.10	8	Abreast Sturgeon Point Wharf.	2	...do...	600+	SE.	...do....	....	7.2	190	....	+ 1	....
14	7.30 a. m.	9	5 miles above Sturgeon Point.	2	Flood.	600	SW.	Clear....	....	6.6	210	....	+ 1	....
	8.20	10	Opposite Westover....	2	...do...	600	SW.	...do....	....	6.1	330	....	+ 1	....
	8.40	11	Just below City Point, Va.	2	...do...	600	SW.	...do....	....	5	140	....	+ .1	....
	9.00	12	Just above City Point, Va., mouth Appomattox River.	2	...do...	600	SW.	...do....	....	5	110	....	+ .1	....
	9.40	13	Just above Curls Neck.	2	...do...	600	SW.	...do....	....	5	380	....	+ .01	....
	10.10	14	Just above Dutch Gap.	2	...do...	600	SW.	...do....	....	5	6,000	....	+ .01	....
	10.35	15	Just above Drewry's Bluff.	2	...do...	600	SW.	...do....	....	5	800	....	+ .01	....
	11.00	16	Opposite White Club House on South Bank.	2	...do...	600	SW.	...do....	....	5	500	....	+ .01	....
	11.20	17	1 mile below Virginia-Carolina Chemical Co.'s fertilizer works.	2	...do...	600	SW.	...do....	....	5	700	....	+ .01	....
	11.30	18	At lower wharves, Richmond, Va.	2	...do...	600	SW.	...do....	....	5	700	....	+ .1	....
16	7.45	19	Do........	2	Ebb...	600	NW.	...do....	....	1.1	760	....	+ .01	....
	7.50	20	Opposite chemical works (17).	2	...do...	....	NW.	...do....	....	1.1	480	....	+ .01	....
	8.00	21	2 miles below Richmond, Va.	2	...do...	....	NW.	...do....	....	1.1	680	....	+ .01	....
	8.30	22	5 miles below Richmond, Va.	2	...do...	....	NW.	...do....	....	1.1	650	....	+ .01	....
	9.00	23	¼ mile above Dutch Gap.	2	...do...	....	NE.	...do....	....	1.1	820	....	+ .1	....
	9.45	24	Curls Neck at upper wharf.	2	Flood.	....	NE.	...do....	....	2.2	430	....	+ .1	....

	12.30 p. m.	25	10 miles below at upper wharf.	2	...do...	....	NE.	...do.....	....	3.0	1,060	....	+ .01	....
	1.00	26	Above junction with Appamattox River.	2	...do...	....	NE.	...do.....	....	3.0	310	....	+ .1	....
	1.15	27	City Point below junction with Appomattox River.	2	...do...	....	NE.	...do.....	....	3.0	370	....	+ .1	....
	2.02	28	Wind Mill Point......	2	...do...	....	NE.	...do.....	....	3.0	200	....	+ .1	....
	2.50	29	1 mile below Sturgeon Point.	2	...do...	....	NE.	...do.....	....	3.0	390	....	+ 1	....
	3.18	30	Just below Claremont.	2	Ebb...	....	NE.	...do.....	....	3.0	110	....	+ .1	....
	3.35	31	Opposite mouth Chickahominy River.	2	...do...	....	NE.	...do.....	....	3.0	190	....	+ 1	....
	4.03	32	Jamestown Island.....	2	...do...	....	NE.	...do.....	....	3.0	150	....	+ 1	....
	4.55	33	At Hog Island wharf..	2	...do...	....	NE.	...do.....	1.0065	4	100	....	+ 1	....
17	7.30 a. m.	34	2 miles below Hog Island wharf.	2	Flood.	600	NE.	...do.....	....	3.3	1,000	....	+10	....
	8.30	35	Deep shoal light about 200 yards; black spar buoy about 200 yards.	10	...do...	80	NE.	...do.....	1.0055	3.3	300	19,000	+10	0
	8.45	36	Between Mulberry Point and Spar buoy.	9	...do...	60	NE.	...do.....	1.0065	3.3	300	2,100	+10	3
	9.30	36½	Near red buoy to west of cut-off channel.	2	...do...	80	NE.	....	1.0075	3.6	250	....	+10	....
	9.40	37	Near Watch House, Point of Shoals, about 500 yards NW. of east red buoy at cut-off channel.	9	...do...	80	NE.	....	1.0085	4.4	145	800	+10	32
	10.15	37½	Midway between Jail Island and Days Point.	2	...do...	15	NE.	....	1.0105	4.5	170	....	+10	....
	10.25	38	500 yards SW. of Jail Island.	12	...do...	15	NE.	....	1.0105	4.4	40	2,100	+10	50
			Warwick River:											
	10.50	39	Off Curtis Point...	8	...do...	0	NE.	....	1.0105	4.2	49	400	+10	3
	11.30	40	Fichett's residence on point.	4	...do...	0	NE.	....	1.0100	2.5	34	1,400	+10	2
	11.45	41	300 yards east Curtis Point "Lands End."	4	...do...	0	NE.	....	1.0105	2.5	21	1,300	+10	5
	12.00	42	200 yards off Young's store.	3	...do...	0	NE.	....	1.0105	2.2	21	9,200	+10	2
	12.30 p. m.	43	200 yards off Yellow clay-bank.	4	...do...	0	NE.	....	1.0105	2.2	19	1,200	+10	3
Feb. 9	1.50	1	Pig Point Light W., Newport News Light NE., elevator N. by W.	8	...do...	25	NW.	....	1.0060	5	250	7,600	− 1	

Table showing results of examinations of individual samples of shellfish and waters of Chesapeake Bay—Continued.

Date.	Hour.	Number.	Location at which sample was taken.	Depth.	Tide.	Turbidity.	Wind.	Weather.	Salinometer reading.	Temperature.	Colonies per cubic centimeter.		Smallest quantity of water from over bed in which *B. coli* was present.	Score based on *B. coli* in shell liquor.
											From water over bed in agar for 24 hours, at 37° C.	From shell liquor in agar for 72 hours, at 20° C.		
			MISCELLANEOUS SERIES—continued.											
			James River, Va.—Contd.	*Feet.*					*Salinometer.*	° *C.*			*C. c.*	
1914. Feb. 8	2.00 p. m.	2	Pagan Creek SW. by W., Newport News Light NE. by N., elevator N. by W.	12	Flood.	50	NW.	....	1.0060	5	540	2,400	+ 1	1
	2.15	3	Nansemond Light SSW., Newport News Light E. by N., elevator N.	8	...do...	100	NW.	....	1.0060	5	600	3,000	+ .1	2
Oct. 6	11.45	1	Pagan Creek, Smithfield, at Gwaltney's Wharf.	2	High..	30	E.	Clear....	1.0125	20	3,100	....	+ .1	....
	12.00	2	Opposite house with pergola, 500 yards below 1.	2	High ebb.	30	E.	...do.....	1.0125	20	6,500	....	— .1	....
	12.10	3	Opposite drawbridge..	3	High..	30	E.	...do.....	1.0125	20	10,000	....	—10	....
	12.20	12	Below drawbridge, left side of channel 1 mile below Smithfield.	7	Ebb...	20	E.	...do.....	1.0120	21	2,750	500,000	+ .01	23
	12.30	13	Opposite black beacon above clay bank.	7	...do...	25	E.	...do.....	1.0125	21	1,750	200,000	— .1	3
	12.25	14	Cove above Red Point, south of channel.	7	...do...	30	E.	...do.....	1.0130	21	36	150,000	+ 1	3
	12.35	15	500 yards below beacon, opposite Red Point.	4	...do...	30	E.	...do.....	1.0130	21	24	100,000	+ 1	2
	1.00	16	Off south bank, 150 yards above shipyard, Battery Park.	6	...do...	20	E.	...do.....	1.0140	21	18	300,000	+10	41
	1.30	17	Isle of Wight Oyster Co.'s bed north of a line between red beacon and wharf.	....	...do...	20	E.	...do.....	1.0140	21	30	100,000	+ 1	32
			Nansemond River:											
3	10.35 a. m.	45	One-half mile above Trotman's Wharf, in channel.	15	Flood.	10	NE.	Cloudy..	1.0150	18	42	4,200	+ 1	0

	11.00	46	North side channel opposite farm, Flue Jones' bed.	4	...do...		5	NE.	...do....	1.0155	18	52	4,700	+10	2
	11.15	47	Above Wilis Island, J. F. Pope's bed.	8	Ebb...		5	NE.	...do.....	1.0155	18	22	1,700	−10	4
	11.45	48	Off Wilson's wharf ...	12	...do...		5	NE.	...do.....	1.0155	18	....	2,900	....	1
	9.25	a	At Suffolk Wharf.....	8	Flood.		30	NE.	Clear....	1.0070	18	245	....	+10	....
	9.40	b	1 mile below Suffolk Wharf.	2	...do...		35	NE.	...do.....	1.0075	18	115	....	+ 1	....
	9.47	c	At clay bank landing..	2	...do...		20	NE.	...do.....	1.0090	18	68	....	+ 1	....
	10.00	d	Kaufman & Wright's landing.	2	...do...		10	NE.	...do.....	1.0130	18	80	....	+10	....
	10.15	e	1 mile below Kaufman & Wrights' Landing.	2	...do...		10	NE.	...do.....	1.0135	18	40	....	+10	....
	10.25	f	At entrance Western Branch.	2	...do...		5	NE.	...do.....	1.0140	18	104	....	+10	....
			Broad Rock:												
	2.40 p. m.	18	Bush Bluff Lightship NE., Lambert Point Pier SE.	9	Ebb...		5	NE.	...do.....	1.0160	18	12	100,000	+10	14
	2.45	19	(East edge) Bush Bluff Lightship, NE. by N., Craney Island, S., 200 yards north of Red Buoy No. 22.	9	...do...		5	NE.	...do.....	1.0160	18	23	150,000	+ 1	50
			James River:												
1915. Jan. 28	9.45 a. m.	1	Abreast C. & O. passenger pier.	3	...do...		5	NW.	Thick...	1.0090	6.1	29	....	+ 1	....
	9.50	2	Abreast C. & O. coal pier.	3	...do...		5	NW.	...do.....	1.0090	6.1	40	....	+10	....
			Hampton Roads:												
	9.55	3	Spar 7, entrance Cut Off Channel.	3	...do...		5	NW.	...do.....	1.0090	6.1	45	....	+ 1	....
	10.00	4	Light Buoy No. 5, Cut Off Channel.	3	...do...		5	NW.	...do.....	1.0090	6.1	74	....	+ 1	....
	10.05	5	Light Buoy No. 3, Cut Off Channel.	3	...do...		5	NW.	...do.....	1.006[illegible]	6.1	68	....	+ 1	....
	10.06	6	Light Buoy No. 1, Cut Off Channel.	3	...do...		5	NW.	...do.....	1.0090	6.1	56	....	+10	....
			Elizabeth River:												
	10.18	7	Bell buoy No. 2, entrance to channel.	3	...do...		5	NW.	...do.....	1.0090	6.1	42	....	+ 1	....
	10.28	8	Light buoy No. 8, river channel.	3	...do...		5	NW.	...do.....	1.0090	6.1	64	....	+ 1	....
	10.32	9	Light buoy No. 12a, river channel.	3	...do...		5	NW.	...do.....	1.0090	6.1	52	....	+ 1	....
	10.38	10	Bush Bluff Lightship, river channel.	3	...do...		5	NW.	...do.....	1.0090	6.1	74	....	+ 1	....
	10.43	11	Red buoy No. 22, river channel.	3	...do...		5	NW.	...do.....	1.0090	6.1	114	....	+ .1	....

Table showing results of examinations of individual samples of shellfish and waters of Chesapeake Bay—Continued.

Date.	Hour.	Number.	Location at which sample was taken.	Depth.	Tide.	Turbidity.	Wind.	Weather.	Salinometer reading.	Temperature.	Colonies per cubic centimeter.		Smallest quantity of water from over bed in which *B. coli* was present.	Score based on *B. coli* in shell liquor.
											From water over bed in agar for 24 hours, at 37° C.	From shell liquor in agar for 72 hours, at 20° C.		
			MISCELLANEOUS SERIES—continued.	*Feet.*					*Salinometer.*	° *C.*			*C. c.*	
1915. Jan. 28	10.50 a. m.	12	Craney Island Lighthouse, Elizabeth River channel.	3	Ebb..	5	NW.	Thick ..	1.0090	6.1	126	....	+ .1	....
	10.57	13	Off Lambert Point Pier, Elizabeth River channel.	3	...do...	5	NW.	...do.....	1.0090	6.1	160	....	+ 1	....
			Craney Island Flats:											
29	10.45	14	Hospital on Island SW., Lighthouse SE.	12	...do...	5	NW.	...do.....	1.0090	4.0	45	3,800	+ 1	....
	10.55	15	Craney Island light SE. by S., Virginia pier NNE., buoy No. 22, NE. by E.	12	...do...	5	NW.	...do.....	1.0090	4.0	126	1,800	+10	4
	11.05	16	Craney Island light E.-SE., Virginia pier N. by E. ½ E.	12	...do...	5	NW.	...do.....	1.0090	4.0	64	400	+ 1	6
	11.15	17	Craney Island light SE., Sewell Point, NE. by N., Middle ground light NW. by N. ½ N.	12	...do...	5	NW.	...do.....	1.0090	4.0	108	2,400	+10	3
	11.30	18	Craney Island light E.-SE. ½ E., Sewell Point, NE. by N., Middle ground NW. by W.	10	...do...	5	NW.	...do.....	1.0090	4.0	80	400	+ 1	4
	11.40	19	Craney Island E.-SE. ½ E., Sewell Point, NE. ½ N., Middle ground N.-NW. ½ N.	12	...do...	5	NW.	...do.....	1.0090	4.0	56	500	+10	2
	11.55	20	Craney Island light E. by S., Sewell Point. E.-NE. ½ E., Middle ground N.	10	...do...	5	NW.	...do.....	1.0090	4.0	65	1,600	+10	1
	12.10	21	Nansemond light W. by N., Pig Point W. ½ S., Middle ground N.-NE.	12	...do...	5	NW.	...do.....	1.0090	4.0	69	3,600	+10	0

1914.			Elizabeth River Va., Eastern Branch:											
Sept. 28	9.25	1	500 yards off Bartin Meyers Point and Southgates, Conklin's bed.	2	...do...	....	NE.	Clear....	1.0152	19.5	100	60,000	+ .1	32
	9.30	2	200 yards below Southgates' oyster-shell mill.	2-3	...do...	....	NE	...do.....	1.0152	19.5	170	1.200	+ .1 0	41
	9.55	3	Broad Creek, 200 yards above Virginia Beach Railroad bridge.	4	...do...	....	NE.	...do.....	1.0152	19.5	110	2,900	− .10	23
	10.13	4	150 yards off Ingleside.	2-4	...do...	....	NE.	...do.....	1.0152	19.5	80	2.000	+ 1	50
	10.20	5	300 yards above Virginia R. R. bridge.	2-4	Flood.	....	NE.	...do.....	1.0152	19.5	110	2,900	+ .1	320
			Indian Creek—											
	10.40	6	100 yards off Davidson's residence.	6	...do...	....	NE.	...do....	1.0152	19.5	100	3,900	+ 1	41
	10.47	7	125 yards north of Oaklet bridge.	6	...do...	....	NE.	...do....	1.0152	19.5	160	4,300	+ 1	23
	10.55	8	50 yards off Hyslop's farm.	4	...do...	....	NE.	...do....	1.0152	19.5	150	3,000	+ .1	41
	11.00	9	At Virginia railway bridge.	2	...do...	....	NE.	...do....	1.0152	19.5	110	....	+ 1	....
	11.10	10	Opposite Oaklet trestle between Virginia railway bridge and Campostello bridge.	2	...do...	....	NE.	...do....	1.0152	19.5	240	....	+ .1	....
	11.20	11	Below Campostello bridge and 200 yards above sewer.	2	...do...	....	NE.	...do....	1.0152	19.5	150	....	+ .1	....
	11.25	12	Below Campostello bridge and Norfolk & Western R. R. bridge 75 yards off sewer.	2	...do...	....	NE.	...do....	1.0152	19.5	2,400	....	+ 1−1	....
	11.40	13	Opposite Berkeley sewer abreast Norfolk & Western station.	2	...do...	....	NE.	...do....	1.0152	19.5	3.100	....	+ .01	....
	11.50	14	Opposite Old Dominion Pier, 200 yards off.	2	...do...	....	NE.	...do....	1.0152	19.5	29,600	....	+ .01	....

Table showing results of examinations of individual samples of shellfish and waters of Chesapeake Bay—Continued.

Date.	Hour.	Number.	Location at which sample was taken.	Depth.	Tide.	Turbidity.	Wind.	Weather.	Salinometer reading.	Temperature.	Colonies per cubic centimeter.		Smallest quantity of water from over bed in which *B. coli* was present.	Score based on *B. coli* in shell liquor.
											From water over bed in agar for 24 hours, at 37° C.	From shell liquor in agar for 72 hours, at 30° C.		
			MISCELLANEOUS SERIES—continued.											
			Elizabeth River, Va., Eastern Branch—Con. Indian Creek—Con.	*Feet.*					*Salinometer.*	° *C.*			*C. c.*	
1914. Oct. 23	8.55 a. m.	8	Same location as No. 1, Sept. 28, chart.	2	Flood.	....	NE.	Cloudy..	1.0150	18.1	31	14,400	+ .1	4
	9.00	9	Same location as No. 2, Sept. 28, chart.	2-3	...do..	....	NE.	...do....	1.0150	19	30	10,000	+ .1	23
	9.05	10	Same loncation as No. 3, Sept. 28, chart.	4	...do..	....	NE.	...do....	1.0145	18.6	38	11,400	+ 1	32
	9.30	11	Same location as No. 4, Sept. 28, chart.	4	...do..	....	NE.	...do....	1.0150	19	48	9,800	+ .1	41
	9.45	12	Same location as No. 5, Sept. 28, chart.	2-4	...do..	....	NE.	...do....	1.0150	19.5	110	12,500	+ .1	230
	9.50	13	Same location as No. 6, Sept. 28, chart.	6	...do..	....	NE.	...do....	1.0150	19	90	33,000	+ .1	5
	10.00	14	Same location as No. 7, Sept. 28, chart.	5	...do..	....	NE.	...do....	1.0155	19.2	110	6,800	+ 1	5
	10.00	15	Same location as No. 8, Sept. 28, chart.	4	...do..	....	NE.	...do....	1.0150	19.5	190	4,400	+ .1	14
	10.25	16	Near mouth of Indian Creek, 200 yards off Mr. Kemp's house, Conklin's lower bed.	4	...do.	10	NE.	...do....	1.0150	19.5	130	7,600	+ .1	50
	10.35	17	Same as chart 9, Sept. 28.	2	...do..	....	NE.	...do....	1.0150	19.5	300	....	+ .1	....

	10.38	18	Same as chart 10, Sept. 28.	2	...do..	....	NE.	...do....	1.0150	19.5	630	....	+ .01	....
	10.40	19	Same as chart 11, Sept. 28.	2	...do..	....	NE.	...do....	1.0150	19.8	1,330	....	+ .01	....
	10.40	20	Same as chart 12, Sept. 28.	2	...do..	....	NE.	...do....	1.0150	19.8	1,700	....	+ .01	....
	10.45	21	Same as chart 13, Sept. 28.	2	...do..	....	NE.	...do....	1.0150	19.8	400	....	+ .01	....
	10.50	22	Same as chart 14, Sept. 28.	2	...do..	....	NE.	...do....	1.0150	19.8	1,000	....	+ .01	....
			Elizabeth River, Western Branch:											
Oct. 1	8.40	19	25 yards from shore at Isham's farm, mud stirred up by planting.	12	High tide.	6,800	NW.	Clear....	1.0160	20	[1] 180 [2] 180	1,000,000	− 1 − 1	0
	9.15	20	At Southern R. R. bridge, 50 yards from shore.	4	Ebb..	....	NW.	...do....	1.0160	20	320	100,000	+ 1	0
	9.30	21	Above A. C. Line Co. bridge, at Nichols Wharf.	4	...do..	....	NW.	...do....	1.0162	18	100	300,000	+ 1	1
	9.35	22	Below A. C. Line Co. bridge, off mouth of creek.	4	...do..	....	NW.	...do....	1.0163	18.2	80	400,000	− 1	2
	9.50	23	400 yards above Electric Co. bridge, 200 yards from shore, Nelson's bed.	4	...do..	....	NW.	...do....	1.0160	18.2	70	4,400	− 1	0
	10.00	24	5 yards below Electric Co. bridge, near N. shore, Bailey's bed.	4	...do..	....	NW.	...do....	1.0160	18	110	300,000	− 1	0
	10.05	25	75 yards SW. of Wise's residence.	7	...do..	0	NW.	...do....	1.0165	18	60	1,000,000	+ 1	4
			Elizabeth River:											
	10.15	26	75 yards above Planters Mfg. Co. wharves.	15	...do..	0	NW.	...do....	1.0160	18	130	400,000	− 1	5
	10.30	27	Opposite Lambert Point, piers Herring Watch House WSW., end of dump SE. by E.	6	...do..	0	NW.	...do....	1.0170	18.2	90	3,000,000	− 1	1
	10.32	28	Opposite Lambert Point piers, 200 NW. of shore.	6	...do..	0	NW.	...do....	1.0179	18.2	70	310,000	− 1	0
	10.45	29	Opposite chimney of smelter, SSW. lower pier E., Fleming's bed.	9	...do..	0	NW.	...do....	1.0170	18.2	70	1,200,000	− 1	0

[1] Surface.

[2] Bottom.

Table showing results of examinations of individual samples of shellfish and waters of Chesapeake Bay—Continued.

Date.	Hour.	Number.	Location at which sample was taken.	Depth.	Tide.	Turbidity.	Wind.	Weather.	Salinometer reading.	Temperature.	Colonies per cubic centimeter.		Smallest quantity of water from over bed in which *B. coli* was present.	Score based on *B. coli* in shell liquor.
											From water over bed in agar for 24 hours, at 37° C.	From shell liquor in agar for 72 hours, at 20° C.		
			MISCELLANEOUS SERIES—continued.											
			Elizabeth River—Contd.	*Feet.*					*Salinometer.*	*°C.*			*C.c.*	
1914. Oct. 1	11.00 a. m.	30	Craney Island SE., end of coal pier NW., White's bed.	6	Ebb..	0	NW.	Clear....	1.0170.	....	80	2,800,000	− .1	3
	11.05	31	Channel, 200 yards off Lambert Point pier.	2	...do..	0	NW.	...do....	1.0170	18	118	....	+10	....
	11.20	32	Channel, opposite Southern Ry. pier No. 3.	2	...do..	0	NW.	...do....	....	18	136	....	+10	....
	12.00	33	Channel, off Naval Hospital pier.	2	...do..	0	NW.	...do....	....	18	108	....	+ 1	....
24	9.25	17	Same as chart 20, Oct. 1, 1914.	4	Flood.	....	NE.	...do....	1.0155	19	51	12,800	+ 1	2
	9.30	18	Same as chart 22, Oct. 1, 1914.	....	...do..	....	NE.	...do....	1.0155	18.7	81	3,100	+ 1	4
	9.50	19	Same as chart 23, Oct. 1, 1914.	....	...do..	....	NE.	...do....	1.0160	18.7	57	3,800	+10	5
	10.10	20	Same as chart 24, Oct. 1, 1914.	....	...do..	....	NE.	...do....	1.0160	19.25	130	1,500	+ 1	2
	10.30	21	Same as chart 26, Oct. 1, 1914.	14	...do..	....	NE.	...do....	1.0160	19.5	160	200,000	+ 1	50
	10.40	22	Same as chart 27, Oct. 1, 1914.	....	...do..	....	NE.	...do....	1.0165	19.5	150	1,100	+ 1	14
	11.10	23	Same as chart 28, Oct. 1, 1914.	....	...do..	....	NE.	...do....	1.0170	19.5	380	800	+ 1	32
	11.18	24	Same as chart 29, Oct. 1, 1914.	5	...do..	....	NE.	...do....	1.0170	19.5	120	900	+ 1	3
	11.35	25	Same as chart 30, Oct. 1, 1914.	....	...do..	....	NE.	...do....	1.0170	19.5	560	2,500	+ 1	14
	11.45	26	Same as chart 44, Oct. 1, 1914.	....	...do..	....	NE.	...do....	1.0170	19.5	1,700	35,000	+ .1	140
	11.40	....	100 yards off Lambert's Point coal pier.	2	...do..	0	NE.	...do....	1.0170	19.5	250,000	....	+ 1	....

25	8.30	31	Tanners Creek— 200 yards below Indian pole bridge, 15 yards off shore.	12	High water.	0	NE.	...do....	1.0160	18.5	1,060	150,000	+ .01	1
	8.40	32	Above Indian pole bridge, 25 feet off Cromwells, City Park, S. W. Simpson bed.	6	...do..	....	NE.	...do....	1.0165	18.5	710	250,000	+ .01	5
	9.00	33	Above Indian pole bridge, mouth of creek, 200 yards above bridge.	7	Ebb..	....	NE.	...do....	1.0160	18	....	57,500	....	1
	9.15	34	Below Indian pole bridge, opposite sample No. 31.	3	...do..	....	NE.	...do....	1.0165	18	....	60,000	....	2
	9.30	35	Opposite Holland Ferry, Holland's bed.	....	...do..	....	NE.	...do....	1.0160	18.3	265	70,000	+ 1	1
	9.45	36	Off and below Country Club 300 yards.	....	...do..	....	NE.	...do....	1.0160	18.3	120	1,900	+ 1	3
	9.50	37	Lamberts Point pier S., flagpole north shore NW. by W., Backus bed.	6	...do..	....	NE.	...do....	1.0160	18.3	131	8,800	−10	4
	10.00	38	Mouth of, natural rock 200 yards west of Backus watch house.	8	...do..	....	NE.	...do....	1.0165	18.3	148	8,500	÷10	2
	10.15	39	Near mouth E. of channel, black buoy 5a W. ½ S., Virginia pier NNW.	10	...do..	....	NE.	...do....	1.0165	18.3	78	24,500	+10	5
	10.30	40	East of channel, Tanners Point, due E. Craney Island Light NW.	12	...do..	....	NE.	...do....	1.0165	18.3	310	100,000	− 1	2
	10.35	41	East of channel, Tanners Point, E. by N. Craney Island Light SW.	15	...do..	....	NE.	...do....	1.0165	18.3	87	41,000	− 1	5

Table showing results of examinations of individual samples of shellfish and waters of Chesapeake Bay—Continued.

Date.	Hour.	Number.	Location at which sample was taken.	Depth.	Tide.	Turbidity.	Wind	Weather.	Salinometer reading.	Temperature.	Colonies per cubic centimeter.		Smallest quantity of water from over bed in which *B. coli* was present.	Score based on *B. coli* in shell liquor.
											From water over bed in agar for 24 hours, at 37° C.	From shell liquor in agar for 72 hours, at 20° C.		
			MISCELLANEOUS SERIES—continued.											
			Elizabeth River—Contd.											
1914. Oct. 25	10.45 a. m.	42	TannersCreek—Contd. East of channel, Tanners Point Pocahontas sewer S. by W. 1,000 yards, Craney Island due W.	*Feet.*	Ebb ..	....	NE.	Clear....	*Salinometer.* 1.0165	°*C.* 18.3	170	27,000	*C. c.* − 1	4
	10.55	43	Below Lamberts Point pier bearing S. by SW. ½ W. 400 yards off Pocahontas sewer SE. ½ S.	12	...do..	....	NE.	...do....	1.0165	18.3	390	2,000	+ .1	3
	11.00	44	Below Lamberts Point pier, 1,000 yards S. ½ W., black spar W. ½ N.	12	...do..	....	NE.	...do....	1.0165	18.3	870	2,400	+ .1	41
26	2.06 p. m.	27	Same as chart 32, Oct. 2, 1914.	5	...do..	....	SW.	...do....	1.0165	19.3	44	150,000	+ 1	32
	2.22	28	Same as chart 33, Oct. 2, 1914.	7	...do..	....	SW.	...do....	1.0165	19.3	190	11,600	+ 1	32
	2.30	29	Same as chart 31, Oct. 2, 1914.	7	...do..	....	SW.	...do....	1.0165	19.3	42	9,800	+ 1	14
	2.58	30	Same as chart 35 Oct. 2, 1914.	7	...do..	....	SW.	...do....	1.0165	19.3	40	5,500	+10	3
	3.00	31	Same as chart 36, Oct. 2, 1914.	6	...do..	....	SW.	...do....	1.0165	19.5	270	5,200	+ 1	4
	3.15	32	Same as chart 37, Oct. 2, 1914.	10	...do..	....	SW.	...do....	1.0165	19.5	37	9,700	+10	32
	3.25	33	Same as chart 38, Oct. 2, 1914.	12	...do..	....	SW.	...do....	1.0170	19.5	45	12,900	+ 1	32

	3.28	34	Same as chart 40, Oct. 2, 1914.	12	...do..	....	SW.	...do....	1.0165	19.5	45	4,500	+ 1		4
	3.40	35	Below Lamberts Point piers, same as chart 41, Oct. 2, 1914.	....	...do..	....	SW.	...do....	1.0165	19.5	52	3,700	+ 1		23
			Elizabeth River, Southern Branch:												
9	2. p. m.	1	Above old magazine and below guano factory.	4	...do..	High color.	SE.	...do....	....	24	170	300,000	+ 1		5
	2.10	2	Above guano factory..	4	...do..	...do.......	SE.	...do....	....	24	190	400,000	+ .1		14
	....	3	In bend below arsenal.	4	...do..	...do.......	SE.	...do....	....	24	540	....	+ 1	....	
			Elizabeth River:												
Nov. 24	10.50	43	75 feet N. black spar 9a, 100 yards NW. Lamberts Point pier, chart 44.	10	Flood.	0	NW.	...do....	1.0180	6.9	98	8,000	+10		32
	11.05	44	Below pier Lamberts Point on State bed, 100 yards off sewer NW., same as chart 43.	....	...do..	....	NW.	...do....	1.0180	6.9	....	400	....		3
	11.10	45	Below pier Lamberts Point, about same as Chart No. 42.	10-12	...do..	....	NW.	...do....	1.0180	6.9	44	2,200	+ 1		4
	11.20	46	Below Lamberts Point about same as chart No. 41.	12	...do..	....	NW.	...do....	1.0180	7.2	....	200	....		5
	11.15	47	Below pier, Lamberts Point, about 600-800 yards off preceding No. 46.	12	...do..	....	NW.	...do....	1.0185	7.2	67	1,700	+ 1		5
	11.30	48	Below pier Lamberts Point, 100 yards west of 47.	12	...do..	....	NW.	...do....	1.0185	7.2	55	60,000	+10		14
	11.40	49	Opposite mouth of Tanners Creek, Tanners Point NE. 1,000 yards.	14	...do..	....	NW.	...do....	1.0185	7.2	116	3,600	+ 1		23
	12.15	50	East edge of channel near black buoy No. 81.	20	...do..	....	NW.	...do....	1.0180	6.9	20	1,100	−10		32
	12.20	51	East edge of channel black buoy "7" 200 yards, 500 yards below (N) of 5a above.	14	...do..	....	NW.	...do....	1.0185	7.2	66	900	+10		32
	12.25	52	East edge of channel 500 yards north of 51 near black buoy "5," below "7."	....	....	....	NW.	...do....	1.0185	7.2	....	6,800	....		4

Table showing results of examinations of individual samples of shellfish and waters of Chesapeake Bay—Continued.

Date.	Hour.	Number.	Location at which sample was taken.	Depth.	Tide.	Turbidity.	Wind.	Weather.	Salinometer reading.	Temperature.	Colonies per cubic centimeter.		Smallest quantity of water from over bed in which *B. coli* was present.	Score based on *B. coli* in shell liquor.
											From water over bed in agar for 24 hours, at 37° C.	From shell liquor in agar for 72 hours, at 20° C.		
			MISCELLANEOUS SERIES—continued.											
			Elizabeth River—Contd.	*Feet.*					*Salinometer.*	*° C.*			*C. c.*	
1914. Nov. 24	8.30 a. m.	36	Channel opposite Virginia Pier, Sewells Point.	2	Ebb	....	NW.	Clear	1.0180	7.2	36	....	+10	....
	8.32	37	Channel opposite Bush Bluff Lightship.	2	...do...	....	NW.	...do...	1.0180	7.2	58	....	+ 1	....
	8.40	38	Channel opposite Craney Island Lighthouse.	2	...do...	....	NW.	...do...	1.0180	7.2	32	....	+10	....
	8.45	39	Channel opposite Lamberts Point piers.	2	...do...	....	NW.	...do...	1.0180	6.6	320	....	+ 1	....
	8.50	40	Channel opposite Southern R. R. pier No. 6.	2	...do...	....	NW.	...do...	1.0180	6.6	5,000	....	[1]+ .1	....
	8.55	41	Channel opposite Fort Norfolk.	2	...do...	....	NW.	...do...	1.0180	6.6	6,000	....	[1]+ .1	....
	9.00	42	Channel opposite Naval Hospital Wharf.	2	...do...	....	NW.	...do...	1.0180	6.6	6,000	....	[1]+ .1	....
Dec. 2	1 p. m.	17	Broad Rock, Craney Island Light 100 yards S. by E. ½ S.	10	...do...	0	NE.	Fog	1.0175	10	11	2,000	−10	41
	1.10	18	Broad Rock, Craney Island Light 300 yards S. by E.	10	...do...	0	NE.	...do...	1.0175	10	11	1,300	−10	5
	1.20	19	Broad Rock, red channel can buoy No. 22, 200 yards NE. by E.	10	...do...	0	NE.	...do...	1.0175	10	7	500	−10	14
	1.25	20	Red channel can buoy No. 22, 75 yards NE. ½ E.	10	...do...	0	NE.	...do...	1.0175	10	....	1,000	....	25
	1.30	21	Red channel can buoy No. 22, 125 yards SE. ½ E.	10	...do...	0	NE.	...do...	1.0175	10	17	200	+ 1	41

	1.35	22	Red channel can buoy No. 22, 400 yards S. SE.	10	...do...	0	NE.	...do.....	1.0175	10	17	1,400	+ 1	4
	1.40	23	Broad Rock, Bush Light Ship, 1,000 yards NE. by E.	10	...do...	0	NE.	...do.....	1.0175	10	5	500	+10	4
	1.50	24	Broad Rock, Bush Light Ship, 1,700 yards E. by S.	....	...do...	0	NE.	...do.....	1.0175	10	8	1,300	+ 1	4
			Masons Creek:											
Sept. 29	8.30 a. m.	9	Opposite Russell's farm.	2	Low water.	....	E.	Clear....	1.0170	17	27	2,800	+10	1
	8.35	10	Ironmongers bed 500 yards south of No. 9.	2	Ebb ..	....	E.	...do.....	1.0170	17	....	1,700	....	2
	8.45	11	100 yards to West Newton's farm near mouth of creek.	8	...do...	....	E.	...do.....	1.0170	17	32	900	+10	1
			Willoughby Bay:											
	9.15	12	Green Roof house Jamestown over pier, Chamberlain Hotel over Spit Wharf.	4	...do...	....	E.	...do.....	1.0175	17.5	11	2,100	−10	3
	9.35	13	East of No. 12 (Albert Lee's bed).	4	...do...	....	E.	...do.....	1.0175	17.5	....	3,000	....	1
	9.40	14	250 yards east of No. 13.	6	...do...	....	E.	...do.....	1.0175	17.5	12	7,800	−10	5
	10.00	15	150 yards off shore opposite L. A. Watts residence.	5	...do...	....	E.	...do.....	1.0175	17	13	250,000	−10	1
	10.15	16	100 yards NE. of ice companys wharf, 100 yards off shore.	4	...do...	....	E.	...do.....	1.0175	17	6	2,200	+10	1
	10.25	17	Opposite Eighth Street (Kanes bed).	5	...do...	....	E.	...do.....	1.0175	18	24	9,200	+10	1
	10.35	18	75 yards off shore, Mears house.	5	...do...	....	E.	...do.....	1.0175	18	13	6,600	+10	1
			Lynnhaven Bay:											
Oct. 5	10.10	1	Lower entrance Broad Bay, Browns Cove.	2	Flood.	5	NE.	Rain....	1.0175	19	165	200,000	−10	41
	10.27	2	North shore of Broad Bay, Browns bed.	4	...do...	5	NE.	...do.....	1.0165	19	28	250,000	−10	32
	11.15	3	Long Creek or Gut ½ mile east of inlet.	2	...do...	5	NE.	...do.....	1.0185	20	20	150,000	+10	14
	11.30	4	Long Creek at mouth, Mapp's bed.	2	...do...	5	NE.	...do.....	1.0185	20	38	300,000	+ 1	23
	11.30	5	.....do....................	2	...do..	5	NE.	...do....	1.0185	20	38	400,000	+ 1	5
	12.20 p. m.	6	Opposite Dr. Druitts House on Barretts bed.	3	...do...	5	NE.	...do.....	1.0185	20	31	800,000	+10	23
	12.40	7	John Miller near end of arm, barn 75 yards off.	2	...do...	15	NE.	...do.....	1.0170	20	18	250,000	+ 1	23

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[1] Highest dilution incubated.

Table showing results of examinations of individual samples of shellfish and waters of Chesapeake Bay—Continued.

Date.	Hour.	Number.	Location at which sample was taken.	Depth.	Tide.	Turbidity.	Wind.	Weather.	Salinometer reading.	Temperature.	Colonies per cubic centimeter.		Smallest quantity of water from over bed in which *B. coli* was present.	Score based on *B. coli* in shell liquor.
											From water over bed in agar for 24 hours, at 37° C.	From shell liquor in agar for 72 hours, at 20° C.		
			MISCELLANEOUS SERIES—continued.											
			Lynnhaven Bay—Contd.	*Feet.*					*Salinometer.*	*°C.*			*C. c.*	
1914. Oct. 8	12.45 p. m.	8	Biddle bed arm of Western Branch.	4	Flood.	15	NE.	Rain....	1.0170	20	27	60,000	+ 1	22
	1.00	9	Old Donation Creek below "The Glebe" Barretts bed.	5	Ebb..	30	NE.	...do.....	1.0175	20	42	50,000	+ 1	23
	1.30	10	Old Donation Creek W. S. Fentress "Tuppenny Point."		...do..	30	NE.	...do.....	1.0180	20		200,000		1
	2.00	11	East Branch, Mr. Mapp's Cove.	3	...do...	30	NE.	...do.....	1.0175	20	36	100,000	+ 1	5
			Mill Creek, Va.:											
Nov. 12	10.35	1	About 200 yards off Catholic school.	2	...do..	5	SW.	Fair.....	1.0185	10	60	1,100	− 1	5
	10.45	2	About 200 yards off shore, Mrs. Williams' bed and residence.	2	...do..	5	SW.	...do....	1.0185	10.5	20	500	− 1	5
	10.55	3	Lewis bed, opposite Tennis house.	2	...do..	5	SW.	...do....	1.0185	10	10	25,000	− 1	4
	11.10	4	Hawkins bed, 250 yards off Hawkins house.	2	...do..	5	SW.	...do....	1.0185	10	50	900	− 1	14
	11.15	5	Cornelius Allen's bed..	2	...do..	5	SW.	...do....	1.0185	10.5	80	600	− 1	3
	11.30	6	Boyhan's bed.........	2	...do..	5	SW.	...do....	1.0185	10	20	700	− 1	2
	11.40	7	Darby's bed..........	2	...do..	5	SW.	...do....	1.0185	10.5	40	900	− 1	1
	11.50	8	Henderson's bed......	2	...do..	5	SW.	...do....	1.0185	10.5	30	5,400	+ .1	3
	11.55	9	Henry James Boykins bed.	2½	...do..	5	SW.	...do....	1.0185	10.5	50	800	− 1	4
	12.10 p. m.	10	Fuller's bed, off moat outlet.	2	...do..	5	SW.	...do....	1.0185	10.5	50	4,200	− 1	50
	12.25	11	Haywood, south of channel, 75 feet E. of channel.	2	...do..	5	SW.	...do....	1.0185	11.7		400		4

	12.30	12	Haywood Wharf, 50 feet inside mouth of sewer.	2	...do..	5	SW.	...do....	1.0185	11.7	....	3,100	....	41
14	9.00 a. m.	13	Below bridge, 75 yards NW. of guard house.	6	...do..	5	NE.	...do....	1.0185	12.2	11	7,800	+ 1	3
	9.20	14	Below bridge, east of channel, 200 yards W. of guard house.	11	...do..	5	NE.	...do....	1.0185	12.2	7	3,500	+ 1	41
	9.15	15	East of channel, on edge of channel 250 yards below No. 14.	13	...do..	0	NE.	...do....	1.0185	12.2	8	3,400	+ 1	5
	9.25	16	Do.	12	...do..	....	NE.	...do....	1.0185	12.2	24	3,100	+ 1	50
	9.32	17	200 yards west of last (N.) officers' quarters, Fort Monroe.	8	...do..	....	NE.	...do....	1.0185	12.2	7	3,000	+10	14
	9.45	18	200 yards W. of engineers' quarters, Fort Monroe.	10	...do..	....	NE.	...do....	1.0185	12.2	34	3,900	+ 1	32
30	2.30 p. m.	19	50 yards from sluice gate of moat, P. Fuller's bed.	4	Flood.	....	E.	Clear....	....	11.1	26	2,800	+10	41
	2.45	20	200 yards above 9, bed of Ben. Johnson.	....	...do..	....	E.	...do....	....	11.1	20	1,600	+10	32
	2.53	21	Bed of Alex Henderson, near watch box.	6	...do..	....	E.	...do....	....	11.1	8	1,200	−10	1
	3.00	22	Bed of Sam. Haywood, west side of creek.	4	...do..	....	E.	...do....	....	11.1	10	1,100	−10	1
	3.15	23	Bed of John Lewis, western end of bridge	3	...do..	....	E.	...do....	....	11.1	16	8,800	+10	50
	3.30	24	Bed of Howard Horstman, outside bridge.	12	...do..	....	E.	...do....	....	11.1	9	2,700	−10	5
	3.35	25	Bed of Howard Horstman, opposite guard house, outside bridge	....	...do..	....	E.	...do....	....	11.1	8	1,300	−10	5
	3.50	26	Bed of Howard Horstman, under C. & O. Ry. bridge, ½ distance to end.	....	...do..	....	E.	...do....	....	11.1	9	2,200	+10	32
			Hampton Creek:											
10	9.25 a. m.	25	Bed of R. A. Watson..	6	...do..	....	NE.	...do....	1.0185	9.5	920	9,800	+ .1	140
	9.35	26	Bed of E. M. Booker..	6	...do..	....	NE.	...do....	1.0185	9.5	680	7,600	+ .01	23
	9.40	27	Bed of W. A. Wood...	4	...do..	....	NE.	...do....	1.0185	9.5	340	400,000	+ .1	140
	9.45	28	Bed of J. M. Phillips...	4	...do..	....	NE.	...do....	1.0185	9.5	260	48,000	+ .1	41
	9.50	29	Bed of M. A. Booker-Wm. Foster.	5	...do..	....	NE.	...do....	1.0185	9.5	1,150	300,000	+ .01	230
	9.55	30	Bed of W. K. Hudgins, Mrs. Chisman, and H. R. Booker.	5	...do..	....	NE.	...do....	1.0185	9.5	1,000	3,800	+ .1	41
	10.00	31	Bed of H. H. Holt and A. D. Wallace.	4	...do..	....	NE.	...do....	1.0185	9.5	560	5,000	+ .01	32

Table showing results of examinations of individual samples of shellfish and waters of Chesapeake Bay—Continued.

Date.	Hour.	Number.	Location at which sample was taken.	Depth.	Tide.	Turbidity.	Wind.	Weather.	Salinometer reading.	Temperature.	Colonies per cubic centimeter.		Smallest quantity of water from over bed in which *B. coli* was present.	Score based on *B. coli* in shell liquor.
											From water over bed in agar for 24 hours, at 37° C.	From shell liquor in agar for 72 hours, at 20° C.		
			MISCELLANEOUS SERIES—continued.											
			Hampton Creek—Contd.	*Feet.*					*Salinometer.*	°*C.*			*C. c.*	
1914. Nov. 10	10.05 a. m.	32	Bed of H. H. Holt above C. & O. R. R. bridge.	4	Flood.	......	NE.	Clear....	1.0185	9.5	......	2,700	......	50
	10.10	33	Bed of J. M Hall....	4	...do..	......	NE.	...do....	1.0185	9.5	......	2,000	......	140
	10.20	34	Bed of W. V. Wood and W. Eddins.	4	...do..	......	NE.	...do....	1.0185	9.5	......	4,300	......	50
	10.14	32 W	Under Hampton bridge, lower side of trestle.	......	......	......	......	......	1.0185	9.5	610	......	+ .1	......
	10.35	33 W	Off Darling's oyster house.	......	......	......	......	......	1.0185	9.5	560	......	+ .1	......
	10.40	34 W	Off Hall's marine railway.	......	......	......	......	......	1.0185	9.5	360	......	+ .1	......
11	9.30	35	Bed of Samuel Watson, west side of creek.	4	...do...	......	NE.	...do.....	1.0185	9.5	210	3,200	+ .01	41
	9.35	36	Do......	4	...do...	......	NE.	...do.....	1.0185	9.5	......	4,800	......	1
	9.45	37	Bed of E. M. Booker and T. Caines lower bed.	4	...do...	......	NE.	...do.....	1.0185	9.5	140	2,500	+ .1	14
	9.50	38	Bed of Thos. Caine, G. E. McDonald, and N. Raynor.	4	...do...	......	NE.	...do.....	1.0185	9.5	110	8,400	+ 1	41
	10.00	39	Bed of C. H. Phillips..	4	...do...	......	NE.	...do.....	1.0180	9.5	190	2,000	+ 1	41
	10.05	40	Bed of Samuel Watson, upper bed.	4	...do...	......	NE.	...do.....	1.0180	9.5	190	4,[illegible]	+ 1	5
	10.05	41	Bed of J. C. Outten...	4	...do...	......	NE.	...do.....	1.0180	9.5	530	11,000	+ 1	4
	10.25	42	Bed of J. C. Phillips...	3	...do...	......	NE.	...do.....	1.0180	9.5	270	2,500	+ 1	4
	10.45	43	From piles and tonged under Hampton bridge.	6	...do...	......	NE.	...do.....	1.0185	9.5	......	9,400	......	230
17	......	8	Bed of Samuel Watson, same locality as 35-36, Nov. 11.	......	......	......	......	......	......	......	......	4,000	......	140

	....	9	Bed of F. M. Booker, same locality as 37, Nov. 11.	....	....	....	....	....	....	....	....	7,400	....	30
	....	10	Bed of W. K. Hudgins, same locality as 31, Nov. 11.	....	....	....	....	....	....	....	....	13,600	....	320
	....	11	Bed of E. M. Booker, same locality as 26, Nov. 11.	....	....	....	....	....	....	....	....	18,800	....	41
			Hampton Roads, Va.:											
Oct. 30	10.30	1	300 yards off Ivy Avenue Pier bearing NW. by W. lighthouse SSE.	10	Ebb...	0	NW.	Clear....	1.0185	15	8	2,300	+10	41
	10.40	2	500 yards off Ivy Avenue Pier bearing W., lighthouse S.	10	...do...	0	NW.	...do.....	1.0175	15	8	1,800	+10	5
	10.45	3	Elevator WNW., lighthouse S.	11	...do...	0	NW.	...do.....	1.0185	15	9	900	+ 1	4
	11.00	4	Ivy Avenue Pier WSW., lighthouse S.	12	...do...	0	NW.	...do.....	1.0180	15	7	5,300	+10	3
	11.05	5	Ivy Avenue Pier W., lighthouse SSW.	12	...do...	0	NW.	...do.....	1.0185	15	13	1,500	+10	23
	11.08	6	Ivy Avenue W. by S., lighthouse SSW.	9	...do...	0	NW.	...do.....	1.0185	15	10	1,200	−10	5
	11.20	7	Buxton Hospital N., Chamberlin Hotel ENE.	8	...do...	0	NW.	...do.....	1.0185	15	8	1,200	+10	33
	11.25	8	Pressy's pier N., Chamberlain Hotel ENE.	8	...do...	0	NW.	...do.....	1.0185	15	9	1,600	−10	14
	11.32	9	Elevator W., lighthouse SSW.	9	...do...	0	NW.	...do.....	1.0185	15	8	1,000	+ 1	5
	11.47	10	Outside 9 about 200 yards.	10	...do...	0	NW.	...do.....	1.0185	15	9	600	+10	2
Nov. 2	10.10	11	Buxton Hospital W., Soldiers Home NE.	12	...do...	0	SW.	...do.....	1.0180	14.5	7	1,300	−10	1
	10.30	12	Do..................	12	...do...	0	SW.	...do.....	1.0180	14.5	11	400	−10	0
	10.30+	13	Buxton Hospital NW., Chamberlain Hotel NE. by E., Robinson's bed.	10	...do...	0	SW.	...do.....	1.0180	14.5	14	300	+10	0
	....	14	Outshore square from 13.	10	...do...	0	SW.	...do.....	1.0180	14.5	10	700	+ 1	1
	11.05	15	Buxton Hospital NNW., lighthouse SSW.	12	...do...	0	SW.	...do.....	1.0180	14.5	12	500	+10	0
	11.15	16	Pressy Pier NW., elevator SW. by W., lighthouse W. ½ S.	10	...do...	0	SW.	...do.....	1.0180	14.5	16	6,200	−10	1

Table showing results of examinations of individual samples of shellfish and waters of Chesapeake Bay—Continued.

Date.	Hour.	Number.	Location at which sample was taken.	Depth.	Tide.	Turbidity.	Wind.	Weather.	Salinometer reading.	Temperature.	Colonies per cubic centimeter.		Smallest quantity of water from over bed in which *B. coli* was present.	Score based on *B. coli* in shell liquor.
											From water over bed in agar for 24 hours, at 37° C.	From shell liquor in agar for 72 hours, at 20° C.		
			MISCELLANEOUS SERIES—continued.											
			Hampton Roads, Va.—Continued.	*Feet.*					*Salinometer.*	°*C.*			*C. c.*	
1914. Nov. 2	11.20 a. m.	17	Elevator W., Buxton Hospital NNW.	12	Ebb..	0	SW.	Clear....	1.0180	14.5	8	1,900	+10	1
	11.30	18	Lighthouse SW., Buxton Hospital NW.	8	...do...	0	SW.	...do.....	1.0180	14.5	8	5,200	−10	1
	11.45	19	Elevator W., Pressy Pier N.	10	...do...	0	SW.	...do.....	1.0180	14.5	20	3,700	+ 1	0
	11.56	20	Elevator NNW., lighthouse SSW.	10	...do...	0	SW.	...do.....	1.0180	14.5	17	400	+ 1	1
3	9.45	21	Ferry slip N. by W., lighthouse SW. by S., S. Watson's bed.	15	Flood.	0	NE.	...do.....	1.0185	14.5	9	2,000	+10	3
	11.00	22	Ferry slip NW. by N., lighthouse SW. by S.	13	High..	0	NE.	...do.....	1.0185	14.5	12	2,600	−10	2
	11.10	23	Ferry slip NW., Chamberlain Hotel E., Soldiers Home himney NE.	12	Ebb...	0	NE.	...do.....	1.0185	14.5	13	900	−10	0
	11.20	24	Ferry slip, 400 yards, outer beacon 75 yards W., Armstrong bed.	16	...do...	0	NE.	...do.....	1.0185	14.5	13	[1] 350,000	−10	3
	11.30	25	Ferry Slip NW., Chamberlain E., Soldiers' Homechimney NE.	16	...do...	0	NE.	...do.....	1.0185	14.5	15	1,900	−10	14
	11.35	26	Ferry Slip NW., Chamberlain E., by N. Sewell Point pier S. by E.	16	...do...	0	NE.	...do.....	1.0185	14.5	27	700	+ 1	23

	11.40	27	Chimney Soldiers' Home NNE., Ferry sli , NW. by N., Darlings bed.	15	...do...	0	NE...	...do.....	1.0185	14.5	10	2,600	−10	32
	11.50	28	Elevator W. by S., Sewells Point pier SSE., Darlings bed.	16	...do...	0	NE...	...do.....	1.0185	14.5	8	300	+10	2
	11.55	29	Elevator W. by S., Ferry slip NNW., lighthouse SW. by S.	15	...do...	0	NE...	...do.....	1.0185	14.5	8	1,100	+10	2
	11.58	30	Sewells Point pier SE., lighthouse SSW.	15	...do...	0	NE.	...do.....	1.0185	14.5	21	1,300	+10	3
	12.00	31	Elevator W. by S., lighthouse SW. by S.	15	...do...	0	NE.	...do.....	1.0185	14.5	7	2,900	+10	14
4	9.45	32	Elevator W. by S., Pressy's pier WNW.	..	Flood.	0	SW.	...do.....	1.0185	14.7	10	4,800	+ 1	[2] 3
	9.48	33	200 yards south of 32, 100 yards north of Darlings, east of white buoy.	12	...do...	0	SW.	...do.....	1.0180	14.7	8	2,600	+10	5
	9.50	34	Sewells Point pier SE. by S. Chamberlin, NE., by E. Darling's outer bed.	16 20	...do...	0	SW.	...do.....	1.0180	14.7	6	2,500	+10	5
	9.55	35	Ferry slip NNW., elevator W.	20	...do...	0	SW.	...do.....	1.0180	14.5	17	10,500	+1	14
	9.58	36	Ferry slip NNW., elevator W. ½ S. (just north of sample 35).	18	...do...	0	SW.	...do.....	1.0180	14.5	12	800	−10	14
	10.07	37	Ferry slip N. by W., elevator W. by S. (just north of samples 35-37).	17	...do...	0	SW.	...do.....	1.0180	14.5	7	1,300	+10	2
	10.10	38	Ferry slip NNW., Soldiers' Home chimney NE.	14	...do...	0	SW.	...do.....	1.0180	14.5	5	1,700	+ 1	14
	10.20	39	Chamberlin ESE., Soldiers' Home chimney NNE.	12	....	....	....	....	....	....	3	3,000	−10	14
	10.25	40	Armstrong, bed, Ferry Slip NW, by W., Soldiers' Home chimney NE. by N.	16	High slack.	0	SW.	...do.....	1.0180	14.7	12	5,000	+ 1	21
	10.30	41	Armstrong bed, Ferry slip NW. by W., Soldiers' Home chimney NE. by N., inside 40.	15	...do...	0	SW.	...do.....	1.0180	14.5	9	3,500	−10	41

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[1] High count possibly due to ferry boat stirring up mud.

[2] Ten U. S. destroyers 4 battleships, and 5 other vessels in roadstead.

Table showing results of examinations of individual samples of shellfish and waters of Chesapeake Bay—Continued.

Date.	Hour.	Number.	Location at which sample was taken.	Depth.	Tide.	Turbidity.	Wind.	Weather.	Salinometer reading.	Temperature.	Colonies per cubic centimeter.		Smallest quantity of water from over bed in which *B. coli* was present.	Score based on *B. coli* in shell liquor.
											From water over bed in agar for 24 hours, at 37° C.	From shell liquor in agar for 72 hours, at 20° C.		
			MISCELLANEOUS SERIES—continued.											
			Hampton Roads, Va.—Continued.	*Feet.*					*Salinometer.*	° C.			*C. c.*	
1914. Nov. 6	9.20 a. m.	1	Newcomb bed, Ferry slip WNW., Soldiers' Home chimney, NNE.	13	Flood.	0	SW.	Clear....	1.0185	14.2	5	600	−10	1
	9.30	2	Newcomb bed, 400 yards off shore, S. foot La Salle Ave., Soldiers' Home chimney due NE.	14	...do...	0	SW.	...do.....	1.0185	14.2	7	400	−10	0
	9.46	3	Atwoods bed, foot La Salle Ave. N. by E., Soldiers' Home chimney due NE.	12	...do...	0	SW.	...do.....	1.0185	14.2	5	1,000	−10	1
	9.52	4	300 yards from No. 3, Chamberlain Hotel E., chimney Soldiers' Home NE.	12	...do...	0	SW.	...do.....	1.0185	14.2	20	900	−10	5
	10.00	5	Tom Davis bed, La Salle Ave. NW., power plant chimney N.	12	...do...	0	SW.	...do.....	1.0185	14.2	7	500	+10	1
	10.10	6	Wm. Robinsons bed, Chamberlin Hotel E., Soldiers' Home chimney NE.	14	...do...	0	SW.	...do.....	1.0185	14.2	7	1,700	+10	4
	10.15	7	Atwoods bed, Chamberlin Hotel E., Soldier' Home chimney NNE.	10	...do...	0	SW.	...do.....	1.0185	14.2	11	1,000	+10	3

	10.20	8	Atwoods bed, Chamberlin Hotel E. by S., Soldiers' Home chimney NE. by N.	14	...do...	0	SW.	...do.....	1.0185	14.2	7	1,400	+10	3
	10.35	9	Black buoy 600 yards E., Chamberlin E., Soldiers' Home chimney NNE.	12	...do...	0	SW.	...do.....	1.0185	14.2	38	1,500	+10	4
	....	10	Black buoy 150 yards ESE., Soldiers' Home chimney NNE.	12	...do...	0	SW.	...do.....	1.0185	14.2	5	10,000	+ 1	23
			Armstrong bed—											
7	9.30 a. m.	11	Soldiers' Home chimney NE., Chamberlin E.	14	...do...	0	NW.	...do.....	1.0180	13.9	5	3,600	−10	[1] 4
	9.35	12	Soldiers' Home chimney NE. by N., Chamberlin E. by N.	10	...do...	0	NW.	...do.....	1.0180	13.9	10	1,700	−10	2
	9.40	13	Soldiers' Home chimeny NNE., Chamberlin ENE.	8	...do...	0	NW.	...do.....	1.0180	13.9	9	2,000	+ 1	4
	9.45	14	La Salle Ave. NW., Soldiers' Home chimney, NNE.	10	...do...	0	NW.	...do.....	1.0180	13.9	12	5,900	+10	4
	9.52	15	Soldiers' Home chimney, NE. ½ N., Chamberlin E.	12	...do...	0	NW.	...do.....	1.0185	13.9	57	5,000	+10	2
	9.55	16	300 yards SE. of Sample 15.	14	...do...	0	NW.	...do.....	1.0185	13.9	5	3,000	+10	32
	10.00	17	Soldiers' Home chimney NNE., Chamberlin E. by N.	12	...do...	0	NW.	...do.....	1.0185	13.9	13	2,600	+ 1	23
	10.05	18	Soldiers' Home chimney NNE., La Salle Ave. WNW.	14	...do...	0	NW.	...do.....	1.0185	13.9	14	4,600	+10	3
	10.05	18	Soldiers' Home chimney NNE., La Salle Ave. WNW.	12	...do...	0	NW.	...do.....	1.0185	13.9	....	4,600	....	3
	10.13	19	Soldiers' Home chimney NNE., Chamberlain E.	10	...do...	0	NW.	...do.....	1.0185	13.9	23	2,600	−10	4

[1] Anchored in Hampton Roads, 2 battleships, 11 destroyers, and two other vessels.

Table showing results of examinations of individual samples of shellfish and waters of Chesapeake Bay—Continued.

Date.	Hour.	Number.	Location at which sample was taken.	Depth.	Tide.	Turbidity.	Wind.	Weather.	Salinometer reading.	Temperature.	Colonies per cubic centimeter.		Smallest quantity of water from over bed in which *B. coli* was present.	Score based on *B. coli* in shell liquor.
											From water over bed in agar for 24 hours, at 37° C.	From shell liquor in agar for 72 hours, at 20° C.		
			MISCELLANEOUS SERIES—continued.											
			Hampton Roads, Va.—Continued.	*Feet.*					*Salinometer.*	° C.			*C. c.*	
1914. Nov. 7	10.20 a. m.	20	Armstrong bed, Soldiers' Home chimney NNE., Chamberlin E.	12	Flood.	0	NW.	Clear....	1.0185	13.9	45	2,900	+10	3
	10.25	21	Soldiers' Home chimney N. by E., Chamberlin E.	10	...do...	0	NW.	...do.....	1.0180	13.9	19	500,000	+ 1	5
	10.30	22	.....do..................	8	...do...	0	NW.	...do.....	1.0185	13.9	19	150,000	+10	1
	10.35	23	Soldiers' Home chimney NNE., Chamberlin E.	10	...do...	0	NW.	...do.....	1.0180	13.9	52	500,000	−10	3
	10.38	24	Last sample west of channel, buoy to Hampton Roads NNE., Chamberlin E. by N.	12	...do...	0	NW.	...do.....	1.0180	13.9	....	800,000	....	23
18	1.23 p. m.	1	Black can buoy 250 yards SW., Soldiers' Home chimney NNE.	12	Ebb...	....	NE.	...do.....	1.0190	10.5	17	900	+ 1	14
			East of channel—											
	1.40	2	Black buoy NW. by N., Chamberlin due E.	12	...do...	....	NE.	...do.....	1.0185	10.5	12	5,800	+ 1	4
	1.45	3	Soldiers' Home chimney N. by E., Chamberlin E. by S.	8	...do...	....	NE.	...do.....	1.0185	10.5	11	800	−10	5
	1.55	4	Soldiers' Home chimney N. ½ E., Chamberlin E. ½ S.	8	...do...	....	NE.	...do.....	1.0185	10.5	13	900	+ 1	5

	2.00	5	Soldiers' Home chimney over red beacon, Old Point Wharf ESE.	9	...do...		NE.	...do.....	1.0185	10.5	25	800	+ 1	14
	2.10	6	Soldiers' Home chimney NNE., Chamberlin ESE.	10	...do...		NE.	...do.....	1.0185	10.5	3,000	800	+10	32
		7	Phœbus Wharf NE., Old Point Wharf E. by S.	10	...do...		NE.	...do.....	1.0190	10.7	13	1,100	−10	41
19	10.35 a. m.	12	Phœbus House NE., Old Point Wharf SE. by E.	10	Flood		NE.	Rain.....	1.0200	10.5	15	3[illegible]	+ 1	32
	10.45	13	Phœbus House NE. by E., Soldiers' Home chimney NNW.	8	...do...		NE.	...do.....	1.0200	10.5	18	5,200	+ 1	4
	10.50	14	Phœbus House NNE., Soldiers' Home chimney NNW.	8	...do...		NE.	...do.....	1.0200	10.5	27	5,000	+ 1	41
	10.55	15	Phœbus House, about 400 yards N., Chamberlin Hotel, SE.	9	...do...		NE.	...do.....	1.0200	10.5	41	3,800	+ 1	32
	11.00	16	Phœbus NNW., Chamberlin Hotel SE.	10	...do...		NE.	...do.....	1.0200	10.5	14	7,800	−10	32
	11.10	17	Soldiers' Home chimney NW., Chamberlin Hotel ESE.	12	...do...		NE.	...do.....	1.0200	10.5	20	10,000	−10	5
	11.15	18	Soldiers' Home chimney NW. by N., Chamberlin Hotel ESE.	8	First ebb.		NE.	...do.....	1.0200	10	12	8,600	+ 1	5
	11.15	19	Soldiers' Home chimney NNW., Phœbus House N.	10	...do...		NE.	...do.....	1.0200	10	18	8,100	−10	23
	11.25	20	Soldiers' Home chimney N. by W., Chamberlin Hotel E.	8	Ebb...		NE.	...do.....	1.0200		24	11,800	+10	5
	11.25	21	Soldiers' Home chimnew N., Phœbus House NE. by N.	10	...do...		NE.	...do.....	1.0190	10	15	6,400	+ 1	32
20	9.00	22	Soldiers' Home chimney NNE., Chamberlin E. by S.	10	Flood		NE.	Clear....	1.0190	9.5	9	900	+10	4
	9.10	23	Soldiers' Home chimney N. by E., red beacon E. by N.	9	...do...		NE.	...do.....	1.0190	9.5	20	700	+ 1	2

Table showing results of examinations of individual samples of shellfish and waters of Chesapeake Bay—Continued.

Date.	Hour.	Number.	Location at which sample was taken.	Depth.	Tide.	Turbidity.	Wind.	Weather.	Salinometer reading.	Temperature.	Colonies per cubic centimeter.		Smallest quantity of water from over bed in which *B. coli* was present.	Score based on *B. coli* in shell liquor.
											From water over bed in agar for 24 hours, at 37° C.	From shell liquor in agar for 72 hours, at 20° C.		
			MISCELLANEOUS SERIES—continued.											
			Hampton Roads, Va.—Continued.	*Feet.*					*Salinometer.*	°*C.*			*C. c.*	
1914. Nov. 20	9.20 a. m.	24	Soldiers' Home chimney E. by N., Chamberlin ESE.	8	Flood.	....	NE.	Clear ...	1.0190	9.5	27	1,700	+ 1	23
	9.30	25	Soldiers' Home chimney N. by E., Chamberlin SE., 300 yards due south of flagpole.	8	...do...	....	NE.	...do....	1.0190	9.5	15	800	+ 1	23
	....	26	Soldiers' Home chimney N., Chamberlin SE., 250 yards offshore opposite sewer.	9	...do...	....	NE.	...do....	1.0190	9.5	13	2,300	+10	3
	9.35	27	250 yards off mouth creek between Soldiers' Home and Phoebus House.	8	...do...	....	NE.	...do....	1.0190	9.5	15	800	+ 1	5
	9.50	28	Chamberlin SE., Phoebus House N.	8	...do...	....	NE.	...do....	1.0190	9.5	19	2,100	+10	23
	9.55	29	Chamberlin SE., Sewells Point pier SSE.	9	...do...	....	NE.	...do....	1.0190	9.5	12	5,700	+ 1	14
	10.00	30	Chamberlin SE., Sewells Point pier SSW.	8	...do...	....	NE.	...do....	1.0190	9.5	19	1,100	+ 1	41
	10.25	31	Chamberlin SE., offshore from above.	10	...do...	....	NE.	...do....	1.0190	9.5	....	1,700	....	32
Dec. 12	10.25	14	Mouth of Hampton Creek, 300 feet S. of Armstrong Wharf, west edge of channel.	12	Ebb...	0	High NW.	...do....	1.0180	7.5	40	600	+ 1	[1]2
	10.25	15	Mouth of Hampton Creek, 300 feet S. of Armstrong Wharf, west end of channel.	12	...do...	0	High NW.	...do....	1.0180	7.5	1	6,500	....	[3]50

	10.45	16	Inside bed of Wm. Robinson, 350 yards SE. of foot La Salle Avenue.	12	...do...	0	High NW.	...do.....	1.0180	7.5	700	300	+ 1	23
	11.00	17	300 yards off Capt. Chas. Hewins's residence.	10	...do...	0	High NW.	...do.....	1.0180	7.5	9	300	+10	[1]2
	11.30	18	Salters Creek near bridge.	9	Last of ebb.	0	High NW.	...do.....	1.0180	7.2	600	4,300	+ .01	410
	....	15	West of Hampton Creek, 500 yards off fishing hamlet on Armstrong.	2	...do...	0	High NW.	...do.....	....	....	11	....	+10	....
	11.10	18	300 yards east of Pressy's pier, 200 yards off shore.	2	...do...	0	High NW.	...do.....	1.0180	7.2	5	....	−10	....
	11.15	19	200 yards off Buxton Hospital.	2	...do...	0	High NW.	...do.....	1.0180	7.2	4	....	+ 1	....
	12.00	21	50 yards off mouth Salters Creek.	[3]2	...do...	0	High NW.	...do.....	1.0180	7	40	....	+ .01	....
			West End:											
17	2.15 p. m.	44	250 yards SE. end of Ivy Pier near white spar buoy.	10	Ebb...	0	NE.	...do.....	1.0105	2.8	17	1,000	+10	5
	2.25	45	Off Salters Creek 400 yards NNW.	10	...do...	0	NE.	...do.....	1.0105	2.8	21	900	+ 1	4
	2.40	46	Off Salters Creek NW., Lighthouse S., Ivy Avenue Pier S. by W.	9	...do...	0	NE.	...do.....	1.0105	2.8	13	1,300	+ 1	4
	2.45	47	Sewells Point pier, ESE., Lighthouse S. ½ W., Ivy Avenue Pier W.	9	...do...	0	NE.	...do.....	1.0105	2.8	16	1,100	+ 1	3
	3.00	48	Buxton Hospital NNW., mouth Salters Creek W., Chamberlin E. by N.	9	...do...	0	NE.	...do.....	1.0105	2.8	16	10,600	+10	50
	3.15	49	Ferry Slip N., Bates Creek NW. by N., Pressys Pier W.	8	...do...	0	NE.	...do.....	1.0105	2.8	19	900	+ 1	32
	3.30	50	Chamberlin E. by N., Sewells Point pier SSE., Lighthouse SW by S.	9	...do...	0	NE.	...do.....	1.0105	2.8	22	400	+10	41

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[1] Clams.

[2] One oyster.

[3] Bottom.